

PHILADELPHIA ZOO

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Genetics (6th-8th)

Essential Question

Why is the study of genetics such an important aspect of conservation?

Objectives

1. See a general overview of the study of genetics.
2. Demonstrate that the physical appearance of offspring can be used to determine the genetic makeup of both offspring and parents.
3. Discover why genetics is an important part of learning about biodiversity and planning for conservation of at-risk species.

Vocabulary

Gene: a unit of heredity that is transferred from a parent to offspring and determines some characteristic of the offspring

Allele: one of a number of alternative forms of the same gene or genetic locus. The alleles present in DNA form the genotype, which is responsible for the phenotype.

Genotype: a combination of alleles that determines a specific trait

Phenotype: the physical appearance of an organism as determined by its genetic makeup

Homozygous: having identical alleles for a given gene

Heterozygous: having non-identical alleles for a given gene

Recommendations

Read:

["Genetics: From DNA to Designer Dogs"](#) – Kathleen Simpson

Research:

- Other traits, besides hair or fur color, that are passed from parents to offspring
- Traits that are influenced by more than two alleles
- Traits that are linked together and are always passed on together

Discuss:

- What types of traits do we have that we get from our parents?
- Where else can our traits come from?
- How can we change some of our traits? Can animals change their traits?

Classroom Activity

As individuals or groups: Have students use the provided worksheets to learn about genetics and inheritance in gibbons, a species of ape that lives at the Philadelphia Zoo.

Standards

PA Academic: 3.1 B1, 3.1 B2, 3.1 B4, 3.1 B5, 3.1 C2, 4.1 D

Next Generation Science: MS-LS1-4, MS-LS1-5, MS-LS3-1, MS-LS3-5, MS-LS4-2

New Jersey Core Curriculum: 5.1, 5.3A, 5.3D

Common Core: CCSS.ELA-LITERACY.RST.4, CCSS.ELA-LITERACY.RST.7, CCSS.ELA-LITERACY.W.7, CCSS.ELA-LITERACY.SL.1

Genetics and Fur Color

- Students can work as individuals or in groups.
- Time needed: **30 minutes**
- Materials needed: writing utensils, calculators

Background Information

Gibbons are apes that live in tropical rainforests in Asia, including the countries of Bangladesh, India, China, and Indonesia. They like to eat fruit, leaves, and some insects. They usually live around 20 years or more, but the record is 44 years! Gibbons live in small family groups, usually containing one breeding pair and their offspring. Pairs of gibbons usually stay together their entire lives. Gibbons are especially unique because they 'sing.' Each morning, a pair of gibbons will call to one another throughout their territory. Their calls are very loud and sound like singing. Each gibbon has their own distinct part in the duet. These calls serve to alert other animals, and particularly other gibbons, of their territory.

At the Philadelphia Zoo, we have a species of gibbons called white-handed gibbons. We have two adults, a female named Phoenix and a male named Mercury, and their two children. These gibbons have white fur on their hands and faces and have either black or blond hair over the rest of their body.



Gibbon fur color is not linked to being a male or female. It is an inherited trait that is determined by the genes of the mother and father. When our gibbons had babies, we were able to find out genetic information about Phoenix and Mercury. Complete the following worksheet to find out how we were able to learn about our parents from looking at their children!

Gibbon Genes

White-handed gibbons either have black or blonde fur. Their fur color is determined by a **gene** that has two **alleles**. Offspring receive one allele from each parent, which makes up their gene for fur color. For this gene, let's label the two possible alleles **B** for black fur and **b** for blonde fur.

B = black fur **b** = blonde fur

Each allele has an equal chance of being passed on to an offspring. That means that a gibbon may have these combinations of alleles, depending on what they receive from their parents:

BB **Bb** **bb**

The combination of alleles to make up a gene is called a **genotype**. These alleles work together to create the gene for fur color. The visible characteristic of a gene is called a **phenotype**. A gibbon may have a phenotype that is either black fur or blonde fur, but they do not have a mixture of the two. That is because the allele for black fur is **dominant** over the allele for blonde fur. The allele for blonde fur is called **recessive**. If a gibbon has even one **B** allele, it will have black fur. A gibbon would need two **b** alleles and no **B** alleles in order to have blonde fur. This means that the possible genotypes would result in these phenotypes:

BB = black **Bb** = black **bb** = blonde

At the Philadelphia Zoo, our female gibbon is blonde and our male gibbon is black. What are the possible genotypes for each of them?

Phoenix (female): _____ Mercury (male): _____

That means we know the genotype of Phoenix, but we do not know the genotype of Mercury. We do know that he must have at least one **B** allele, since he has black fur. We can use our knowledge of heredity and our observations of their children to find out.

To look at the relationship between genotypes and phenotypes of parents and offspring, we use something called a **Punnet square**. They are squares that have the genotypes of the parents on the outside with each allele in a different row or column:

		MERCURY	
		B	?
PHOENICE	b		
	b		

We can fill in the square by combining the allele on the left with the allele on the top for each internal square:

		MERCURY	
		B	?
PHOENICE	b	Bb	?b
	b	Bb	?b

Since we do not know Mercury's genotype, we can fill out two different Punnet squares, one for each possibility. Then, we can look at his offspring to decide which genotype we think he has.

Complete the two Punnet squares, then answer the questions that follow.

		MERCURY	
		B	B
PHOENICE	b		
	b		

		MERCURY	
		B	b
PHOENICE	b		
	b		

1. If Mercury's genotype is **BB**, what phenotype would his offspring have?
2. If Mercury's genotype is **Bb**, what phenotype would his offspring have?
3. If Mercury's offspring has **black** fur, what genotype does Mercury have?
4. If Mercury's offspring has **blonde** fur, what genotype does Mercury have?

This is a photo of Leo, Phoenix and Mercury's first child.



Based on this observation, what genotype does Mercury have?

Additional exercises

1. Given our knowledge of Mercury and Phoenix's genotypes, calculate the **percentage** of likelihood that one of their offspring would have the following **genotypes** or **phenotypes**:

Genotype	Percent likelihood in a single offspring
BB	
Bb	
bb	
Phenotype	Percent likelihood in a single offspring
Black fur	
Blonde fur	

2. How might gibbon fur color be different if both alleles were expressed equally? That would mean, instead of **B** being dominant over **b**, both alleles would contribute to the phenotype. What might gibbon fur look like?