

How do black bears in the Great Bear Rainforest demonstrate inheritance patterns?

In this activity, students explore genetic inheritance patterns using the black bear population of the Great Bear Rainforest.

Learning Objectives

Students will:

- Construct, analyze, and interpret Punnett squares
- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
- Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world
- Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information
- Understand, over the course of this activity:
 - » the patterns of inheritance
 - » the mechanisms for the diversity of life (mutation and its impact on evolution)

Preparing for the Activity Plan

- Read the background information and preview the videos and websites listed below.
- This activity plan assumes that students are already familiar with these genetic terms: genotype, phenotype, recessive, dominant, allele, homozygous, and heterozygous.
- ([The Biology Project](#) website has a glossary of these terms if needed—see the link below).

Materials

- computer and projector
- student computers / tablets/ devices
- access to the Internet
- Blackline Master 1: Spirit Bear

Background Information and Resources

Tsimshian coastal First Nations have lived peacefully alongside spirit bears for thousands of years.

Called “moksgm’ol,” (white bear) in the local Indigenous language, there are several cultural stories about spirit bears. One of those stories describes how Raven created spirit bears to remind inhabitants how the whole area was covered with ice and snow during the last ice age.

Spirit bears are vital to the flourishing Indigenous-owned ecotourism businesses operating within areas of the Great Bear Rainforest region where the bears can be found.

The spirit bear variation is caused by a homozygous recessive allele on the *Mc1r* gene in the black bear (*Ursus americanus*). This gene is responsible for melanin production. It is believed that most black bears in the Great Bear Rainforest are carriers of the gene (black fur = heterozygous), so it is possible for two black-furred bears to produce cubs with the white fur variation. Although the black-furred allele is dominant to the white-furred allele, the spirit bear still represents a significant part of the black bear population in the Great Bear Rainforest. There is some debate as to whether the spirit bear phenotype is an advantage. The grades 7–9 Activity Plan [Why are spirit bears white?](#) explores this theme.

Videos

Enter the Great Bear Rainforest (4:35)

This video is a great introduction to the Great Bear Rainforest and its inhabitants. It provides footage of black bears that identifies colour variants.

https://www.youtube.com/watch?time_continue=267&v=js1rnKPAAnE0&feature=emb_logo

Great Bear (18:06)

This video explores study and stewardship of bears in which traditional ecological knowledge and science complement one another.

<https://vimeo.com/105569648>

Rainforest Guardians: Spirit Bears and the Gitga'at Nation (3:59)

This short video has excellent black bear footage, with Gitga'at Nation perspective. It supports genetic principles used in this activity, and provides anecdotal evidence of the inheritance patterns of black bears in the Great Bear Rainforest.

<https://www.youtube.com/watch?v=H3vEO8pMWoc>

Speechless—The Great Bear Rainforest (3:27)

This video has footage of the Great Bear Rainforest and the Spirit Bear.

<https://vimeo.com/239028899>

Welcome to the Great Bear Rainforest (2:59)

This video is an excellent introduction to the Great Bear Rainforest and can be used to identify bear phenotypes.

https://www.youtube.com/watch?time_continue=7&v=jAHNqN_8p2k&feature=emb_logo

Informational Websites:

The Biology Project

This website provides a glossary of genetic terms.

http://www.biology.arizona.edu/vocabulary/mendelian_genetics/mendelian_genetics.html

The Canadian Encyclopedia

This website gives an overview of spirit bear genetics and provides ample information on the spirit bear in general.

<https://www.thecanadianencyclopedia.ca/en/article/spirit-bear>

Current Biology

The abstract of this scholarly article on the inheritance and population of the spirit bear has useful information. This resource may be too advanced for some students.

<https://www.sciencedirect.com/science/article/pii/S0960982201004481>

North American Bear Center: Northwoods Ecology Hall

This website gives a succinct overview of the black bear colour variants and where they are located.

<https://bear.org/black-bear-color-phases/>

Delivering the Activity Plan

Access Prior Knowledge

- Show the following videos to give students a glimpse into the rich biodiversity of the area:
 - » [Welcome to the Great Bear Rainforest](#) and/or
 - » [Enter the Great Bear Rainforest](#).
- For a more thorough introduction, see the Grades 7–9 Activity Plans [Where is the Great Bear Rainforest?](#) and [Why are spirit bears white?](#)
- Ask students what they know about the Spirit Bear and black bears in general.
- Show students the video at [Speechless – the Great Bear Rainforest](#). After viewing, have students identify the variations of bears they saw.
- Alternatively, you can use images from The Great Bear Rainforest educational website gallery at <https://greatbearrainforesttrust.org/gallery/mammals/>
- Ask students, “Are these individuals of the same species? How do we know?” (Yes, the spirit bear is a variation of the black bear (*Ursus americanus*) population, and we know this because all members of this group can reproduce to form fertile offspring.)

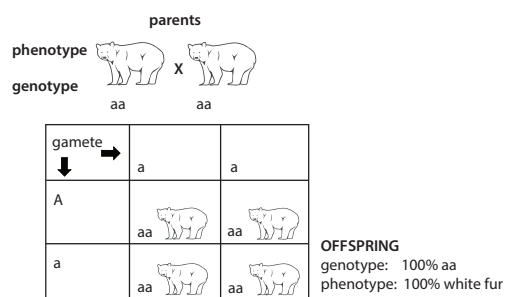
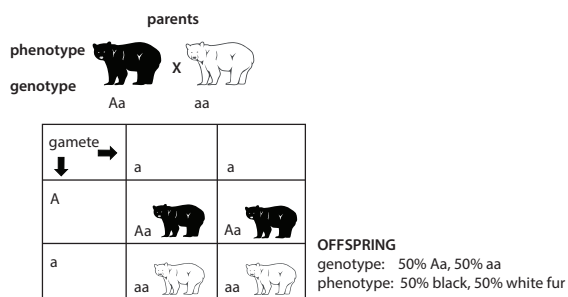
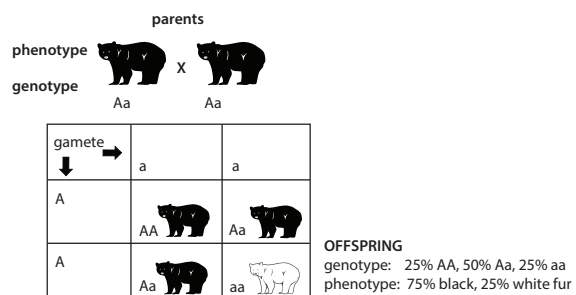
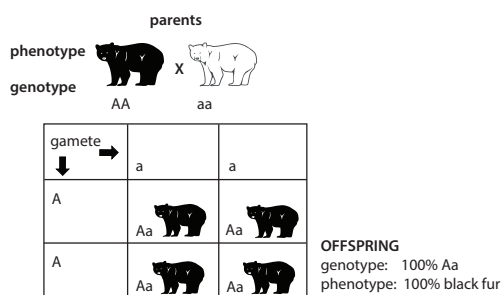
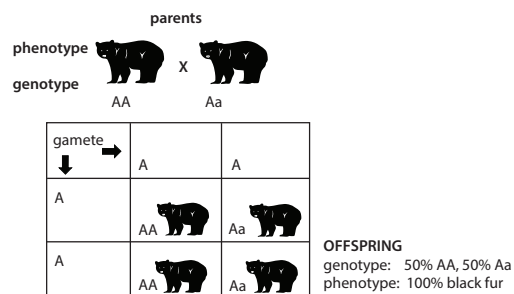
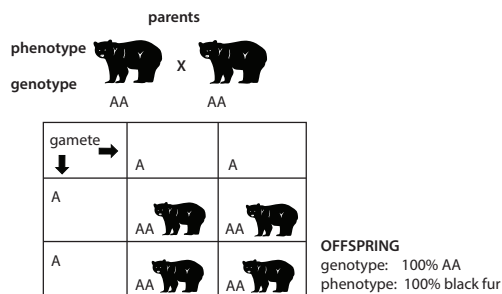
Inquire

- Ask students: What causes the spirit bear variation?
- Students can work in pairs to find an answer to the question on the Internet.
- Alternatively, direct students to the [Canadian Encyclopedia](#) entry on spirit bears.
- Once students have finished research, reconvene the class, and ask for volunteers to give their response to the question.
- Students may find a lot of different information. Focus on responses that include discussion of the homozygous recessive variation of *Mc1r*, a gene that is involved in melanin production.
- Ask follow-up questions, such as the following:
 - » Does this mean that spirit bears are albino? (No.)
 - » Does this gene variation occur in other animals? (*Yes, in people with red hair and blond Labrador retrievers*).

Experience

- Provide each student with a copy of Blackline Master 1: Spirit bear Inheritance to record their work.
- Show the video at [Rainforest Guardians: Spirit Bears and the Gitga'at Nation](#).
- Have students discuss the cultural significance of having Marven Robinson narrate the video.
- Review the point in this video (at 2:27) where the narrator describes how a mother (black coat) that is seen with two black cubs had two white cubs four years ago.
- Ask students how this can be explained using inheritance patterns and Punnet squares.
- Have students create a Punnet square for each possible set of parents: i.e., homozygous dominant, homozygous recessive, and heterozygous (see below).
- Students can then determine the possible genotypes of the parents of the two different sets of cubs.

A = dominant allele (black fur)
a = recessive allele (white fur)



(Tour Guide Canada <https://www.tourguidecanada.com/kermode-bear.html>)

- As students complete their Punnet squares, have them begin to draw conclusions about the frequency of the spirit bear. Do students' Punnet squares explain why the spirit bear is a significant part of the black bear population in the Great Bear Rainforest?

Note: It is believed that all black bears in the Great Bear Rainforest are carriers of the spirit bear gene. (Source: The Great Bear Rainforest Education and Awareness Trust: <https://greatbearrainforesttrust.org/biodiversity/>)

Assess

- Did students find reliable sources of information in their initial research?
- Were students able to construct, analyze, and interpret their Punnet squares?
- How did students use knowledge of scientific concepts to draw conclusions that are consistent with evidence?
- Did students make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world?
- How did students apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information?
- Did students demonstrate an understanding of patterns of inheritance and how mechanisms such as mutation impact the diversity of life?

Go Beyond

- Spirit bears are just one colour variation of the black bear population. Other variations include brown/cinnamon, seen in the cinnamon bear (*Ursus americanus cinnamomun*), and the blue-gray colour seen in the glacier bear (*Ursus americanus emmonsii*). Have students explore the following questions about these variations:
 - » What genotypes are responsible for these colour variations?
 - » Why are these bears found in their habitats, while the spirit bear is primarily located in western North America?
- Students can explore [Why are spirit bears primarily in the Great Bear Rainforest?](#)
- View [Great Bear](#) this video can be used as a starting point to discuss how traditional ecological knowledge and western science can complement one another.

Blackline Master 1
Spirit Bear Inheritance

Name: _____

1. Explain the cultural significance of the spirit bear to local First Nations.

2. After watching the video(s), what variations of black bears did you observe?

3. What causes the spirit bear variation? (Document your research here).

4. In the video "Rainforest Guardians: Spirit Bears and the Gitga'at Nation," a mother with dark fur has cubs with both dark fur and the spirit bear variation. Using Punnet squares, explain how this is possible. For each Punnet square you create, determine the percentage of each genotype and phenotype.

5. Is it possible for two spirit bears to produce a cub with dark fur? Explain how or how not, using a Punnet square(s).



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