Wildcat Identification: Phenotypes and Genotypes

Animals can be identified using a variety of approaches. In centuries past, scientists often used physical features to identify and classify animals. These features, called phenotypic data, are easily identified by looking at an animal and can include things such as shape of their head, color of their outer coverings, structure of their body, type of social groupings, and reproductive strategies. Sometimes, these features are helpful. For example, all animals that have mammary glands can be classified as mammals. However, sometimes phenotypes don't tell a complete story.

With modern technology, scientists can examine the entirety of species' genetic code and compare it with other species to determine evolutionary relationships between those species. This genotypic data often give scientists insights into relationships that aren't obvious at a glance. For example, by looking at an elephant, you might think that their closest relatives are either rhinoceroses or hippopotami since those animals are all large powerful mammals with thick gray skin found in Africa. However, examining their genotypes, scientists have determined that elephants are actually more closely related to the rock hyrax, a small furry mammal that looks more like a groundhog than a rhino. In this activity, your students will learn how scientists use both genotypic and phenotypic data to help with the conservation of the wildcat in Scotland (*Felis silvestris silvestris*). This species is the last wild cat species in the United Kingdom and is approaching extinction.

Objectives:

Students will be able to:
- Calculate a Pelage score (i.e., phenotypic data) to differentiate between wildcats, domestic cats, and hybrids
- Analyze mock DNA sequences (i.e., genotypic data) to differentiate between wildcats, domestic cats, and hybrids
- Critically evaluate the benefits and drawback for both phenotypic and genotypic analysis for wildcat reintroduction efforts

Materials:
- Wildcat in Scotland Worksheet
  - PDF version
  - Editable version
- Cat Identification Photos
- Cat DNA Sequences
- Phenotype versus Genotype Worksheet
  - PDF version
  - Editable version

Process:
1. Students should listen to Series 1 (Scottish Wildcats) of the BBC podcast, "Scotland's Wildlife". This podcast is about 20 minutes long.
   They should then watch the Wildcat Identification: Phenotypes and Genotypes video on the Field Sight page. While listening and watching, students should answer the questions on the Wildcat in Scotland Worksheet.

2. As a class, review the answers on the worksheets. Make sure to point out that wildcats in Scotland prey on small birds and rodents in the wild and these types of apex predators play a critical role in maintaining balance in an ecosystem. Challenge students to discuss the impact that wildcat extinction would have on the bird and rodent populations in Scotland. Also challenge them to think about how changes in those populations would impact other species, including humans. Ask groups to share out their answers in a whole class discussion.

3. Highlight that one of the major threats to populations of wildcats in Scotland is hybridization with feral domestic cats. Hybrid cats are no longer considered wildcats because half of their genetic information is from a different species, in this case feral domestic cats. Explain to students that scientists use both physical (or phenotypic) and genetic (or genotypic) data to ensure that the wildcat in Scotland population remains healthy in the wild.

4. Inform students that they will now act as researchers to help the Royal Zoological Society of Scotland (RZSS) with wildcat conservation. Tell them that RZSS scientists have a group of wildcats in Scotland that they are ready to release into the Cairngorm National Park, but they want to make sure that the release area supports wildcats in Scotland and not feral domestic cats. RZSS scientists have trapped wild cats from two different areas in Cairngorm and have provided two types of data on each cat for students to use to identify which area is a better location to release the new group of wildcats. Students will use the Phenotype versus Genotype Worksheet for this activity.

5. For the first exercise, students will calculate a Pelage score for each of the individual cats. They will use the Cat Identification Photos and Section 1 of the Phenotype versus Genotype Worksheet which includes instructions on how to calculate a Pelage score. After each student has calculated a score, have students work in small groups to discuss their recommendation for which location they think has more wildcats and which has more hybrid cats based on the phenotypic data they have analyzed.

6. For the second exercise, students will compare genetic sequences for each of the individual cats. They will use the Cat DNA Sequences and Section 2 of the Phenotype versus Genotype Worksheet. They will need to compare each individual cat to the genetic sequences of the captive wildcats and a sample sequence from a feral domestic cat. Since the scientists already know that the captive wildcats are not hybrids, students can use this genotypic data to identify which location has more wild cats with wildcat in Scotland genes. After each student has compared the DNA sequences, have students work in small groups to discuss their recommendation for which location they think has more wildcats and which has more hybrid cats based on the genotypic data they have analyzed.

7. Note: As an alternative, you can split the class into two groups: Assign one group of students to complete Section 1 and the other group of students to complete Section 2. After each group has made their reintroduction recommendation, allow the group to debate which type of evidence they think is more compelling.

8. As a whole class or within small groups, have students compare and contrast the benefits of using phenotypic and genotypic data in wildlife conservation. Some questions to ask: Which type of data is more reliable? Why might phenotypic and genotypic data lead to different recommendations? What is an example of a study that scientists could use phenotypic data to answer? What is an example of a study that scientists could use genotypic data to answer?

   NOTE: The activity was designed with ambiguity in mind. Inform students that it is very rare that conservation work ends up with black and white results. Scientists need to use their best judgment to identify which solution works best given the clues. Therefore, provided that students can back up their assertions with logical reasoning, they are using good scientific practice.

Extension Activity:
- If you want to engage your students in more activities related to wildcats of Scotland, consider the Scottish Wildcat Action education package developed by our partners, the educators at the Royal Zoological Society of Scotland's Edinburgh Zoo. There are six modules supporting learners from a variety of ages!

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