The Science Behind Algonquin's Animals

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Who's Yo Daddy?

Grades: 10-12
Subject: science, biology, genetics
Skills: interpretation, graphing, hypothesizing
Duration: 90-120 minutes
Vocabulary: microsatellite loci, microsatellite allele, allele, mitochondrial DNA, DNA, POI, individual index, haplotype, genotype, species, sub-species, hybridization

Objectives:

Students will be able to: 1) graph genetic data from four separate wild canid populations to determine relatedness.
2) interpret the genetic data to draw conclusions of the origin of the Eastern Wolf.

Method:

Students will graph and analyze genetic data from four populations of wild North American canids.

Background:

In Algonquin Provincial Park the top predator is the wolf. Algonquin Park wolves are identifiable by their small size, 25-30 kilograms, and by their colouration; salt and pepper on the back with reddish-cinnamon behind the ears and legs. For many years the wolves in Algonquin Park were believed to be a small sub-species of the Gray Wolf (*Canis lupus*). Gray Wolves, found in northern Ontario, and the rest of Canada, tend to weigh between 50-60 kilograms, and vary widely in colouration. It is this wolf that most people are familiar with from wildlife documentaries and books. Some people also refer to the Gray Wolf as the Timber Wolf. The smaller sub-species found in Algonquin Park has been referred to as the Algonquin-type Wolf and the Eastern Canadian Wolf.

The reason for the small size of Algonquin wolves compared to other Gray Wolves was believed to have been the result of hybridization of Gray Wolves and Coyotes.

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In the late 1990s two geneticists, Brad White and Paul Wilson, from Trent University in Peterborough, Ontario, examined DNA from Algonquin Park wolves, and Red Wolves in the southern United States, and compared them against the DNA of Gray Wolves from the North West Territories in Canada, and Coyotes in Texas. The results showed that not only were Algonquin wolves genetically different from wolves in northern Ontario and the rest of Canada, but they were more closely related to the endangered Red Wolf found in the southern United States. It has been long thought that Red Wolves were actually the result of hybridization with Coyotes. DNA of both Red Wolves and Algonquin Park wolves was compared against the closest Coyote* population to the Red Wolf, that of Texas.

*There are two distinct Coyotes in North America, true Coyotes in western North America and larger Coyotes in northeastern North America, which are sometimes called brush wolves. The larger size is suspected due to hybridization of Gray Wolves and Coyotes as western populations of Coyote pushed eastward with the clearing of large areas of land due to European settlement.

The result showed that, while both the Algonquin wolf population and the Red Wolf population were very closely related genetically, they did not share genotypes with Coyotes. This established that both the Algonquin wolf and the Red Wolf are not hybrids of Gray Wolves and Coyotes. See **Fig. 1**.

The second comparison of Algonquin wolf DNA and Red Wolf DNA was against samples of Gray Wolf DNA from wolves in the North West Territories. Again, the results showed that both the Algonquin wolves and Red Wolves grouped closely together, suggesting a strong genetic relationship. The Gray Wolf DNA grouped separately from Coyote DNA, as was expected, but also grouped separately from that of both Algonquin wolves and Red Wolves. See **Fig. 2**. This meant that not only are Algonquin wolves and Red Wolves genetically similar, it also meant that both are genetically different from Gray Wolves, and therefore a separate species.

While Algonquin Park wolves were largely used as the sample for the Eastern Canadian Wolf (Canis lupus lycaon), further genetic testing showed that this Algonquin-type wolf has a range from southern Manitoba and northern Minnesota, through central Ontario to southwestern Quebec.

As a result of the genetic analysis, a new map of North American wolf populations could be drawn. Originally it was believed that prior to European habitation, most of Canada and the northeastern United Stated was inhabited by Gray Wolves. Red Wolves were found in the southeastern United States with Coyotes inhabiting the western United States and the southern prairies in Canada. It was then believed that with European settlement the Gray Wolf population was extirpated from the northeastern U.S. to the southern range of central Ontario, the Red Wolf was reduced to a small endangered population along the Texas and Louisiana Gulf coast, and Coyotes expanded eastward to inhabit the newly opened areas. See **Fig. 3**.

The new historical perspective now shows that Gray Wolves still dominated most of Canada, and into southern Ontario, but the Red Wolf's range now encompassed all of the eastern United States, with Coyotes still inhabiting the western United States and southern Canadian prairies. With European settlement, the Red Wolf population was split into a northern and southern race, again with the southern race being all but eliminated from the continental United States, and with the northern race moving farther north in Ontario. The reason for the shift north was largely the result of habitat change due to settlement and logging, which enabled new forests to become established. These newer forest were ideal for White-tailed Deer, which expanded their range northwards. As the deer moved farther north, so did their main predator, the northern race of the Red Wolf. Along with this change of habitat the range of the Gray Wolf also changed, as they too moved farther north. Thus the void left by the emigration of the Gray Wolf was filled by the northern race of the Red Wolf, or Eastern Canadian Wolf. Conversely, areas vacated by the Red Wolf, due to habitat loss, were filled by Coyotes, who expanded into southern Ontario and the eastern United States. See **Fig. 4**.

As it was shown that the Algonquin Park (and surround area wolves) were not related to the Gray Wolf, and therefore not a sub-species and could no longer be referred to as *Canis lupus lycaon*, or Eastern Canadian Wolf, a new name was needed. While genetically similar to the Red Wolf, scientists could have called them Red Wolves (*Canis rufus*), but instead decided on a new and distinct name to separate them from their southern relatives, and Eastern Wolf (*Canis lycaon*) was proposed.

Materials:

✓	Items Required	Quantity
	picture of Eastern Wolf (*Canis lycaon*)	one
	picture of Red Wolf (*Canis rufus*)	one
	picture of Gray Wolf (*Canis lupus*)	one
	picture of Coyote (*Canis latrans*)	one
	genetic data sheets*	one per student
	graph paper	two per student
	DNA inquiry sheet	one per student

***Note: The data represented in the tables and graphs does not represent actual calculations done by wolf geneticists. The values given are for instructional purposes only for plotting representative POI graphs. The clustering on the graphs themselves does represent similar clustering from actual log for POI graphs done by wolf geneticists.**

Procedure:

1) Proceed by showing the students the pictures of the four wild canids, Eastern Wolf (formerly eastern Canadian wolf), Red Wolf, Gray Wolf and Coyote. Have these numbered 1 – 4. Do not reveal the species. Once they have had a good look ask them how many species they have just seen. You should get varying answers.
2) Once the students have guessed at the number of individual species, ask them if they can identify the individual species. You will have to group these according to the numerical guesses, e.g. if there was a guess of two species, then list the names under the 'two' guess; if there was a guess of three, then list the names under the 'three' guess, etc. You may also have different species allocations for the same number species guessed, e.g. there were two separate guesses for there being two species but one student believes that the two species are Timber Wolf and Coyote, while another student may believe that the two species are Timber Wolf and Red Wolf. Record all the guesses on the black board or overhead.

3) When all guesses have been exhausted, ask the students how they determined which animal belonged to what species? Record these observations on the black board or overhead. Most of the answers should focus around physical appearance. Ask them if visual appearance is enough to determine individual species from one another.
4) Ask the students what physical attributes they are unable to determine from visualization alone; height, weight etc. If they knew height and weight of an animal would it still be enough to determine individual species?
5) At this point identify the four separate species to the students. Inform them though that one of the species, the Eastern Wolf, is related to at least one of the other species. Ask them if they can tell to which animal(s) the Eastern Wolf is related. As students give their answers ask reasons for their decision.
6) Once students have had a chance to theorize on which species the Eastern Wolf is related to and why, relate to them the information pertaining to the belief in the past that the Eastern Wolf was believed to be a Gray Wolf (*Canis lupus*) but was just a smaller sub-species (*Canis lupus lycaon*).
7) Then relate to the students about the possibility that this Algonquin-type sub-species, previously known as the Eastern Canadian Wolf, may actually be a separate species, and not related at all to the Gray Wolf. Ask the class how wildlife researchers and scientists would determine if the Algonquin-type wolf is related to the Gray Wolf or is a separate species.
8) As DNA is one way to determine if species are related and for determining genetic heritage, explain to the class that they will be using information based on DNA profiles from eight microsatellite loci from samples of four wild canid populations in North America; Gray Wolves (*Canis lupus*) from the North West Territories, captive Red Wolves (*Canis rufus*), Algonquin Park wolves representing the Eastern Wolf (*Canis lycaon*), and Texas Coyotes (*Canis latrans*), to determine the genetic affinity of the Eastern Canadian Wolf to the other three species. They will do this by graphing data that has been obtained from the analysis of DNA samples to determine the Probability of Identity (POI) of each population.
9) When they have completed the graphs have them answer the questions on the DNA inquiry sheet.

Extensions:

Using the vocabulary list, have students define each word.

Evaluation:

Ask students to:

1) Complete and hand in their 2 graphs.
2) Complete and hand in the answers to the DNA inquiry sheet.
3) Hand in vocabulary definitions.

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Fig. 1.

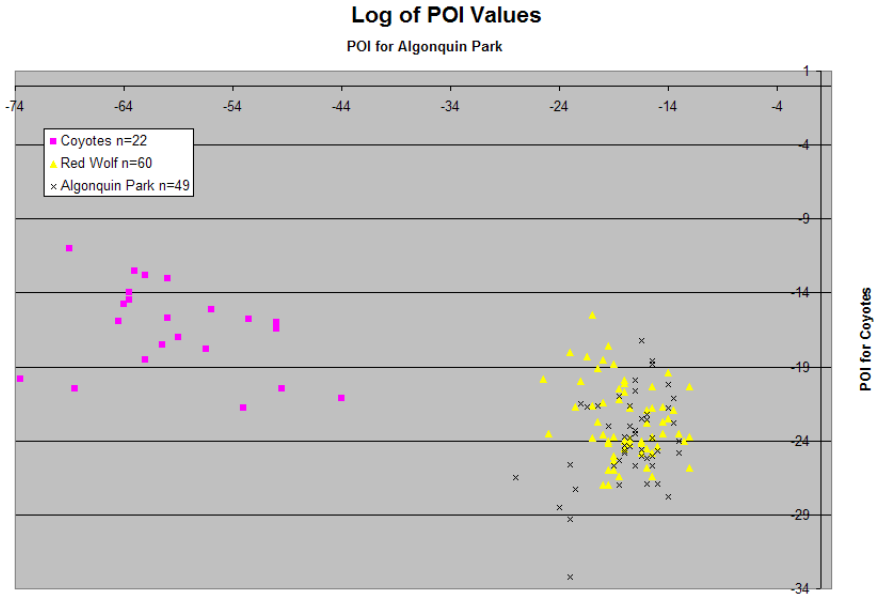
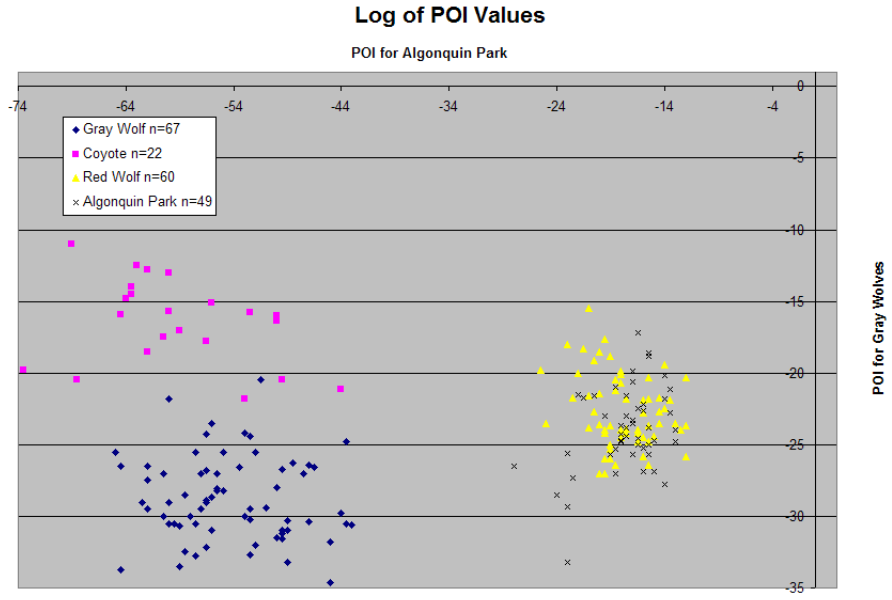


Fig. 2



Ontario Parks

The Friends of Algonquin Park

Ontario

Fig. 3.

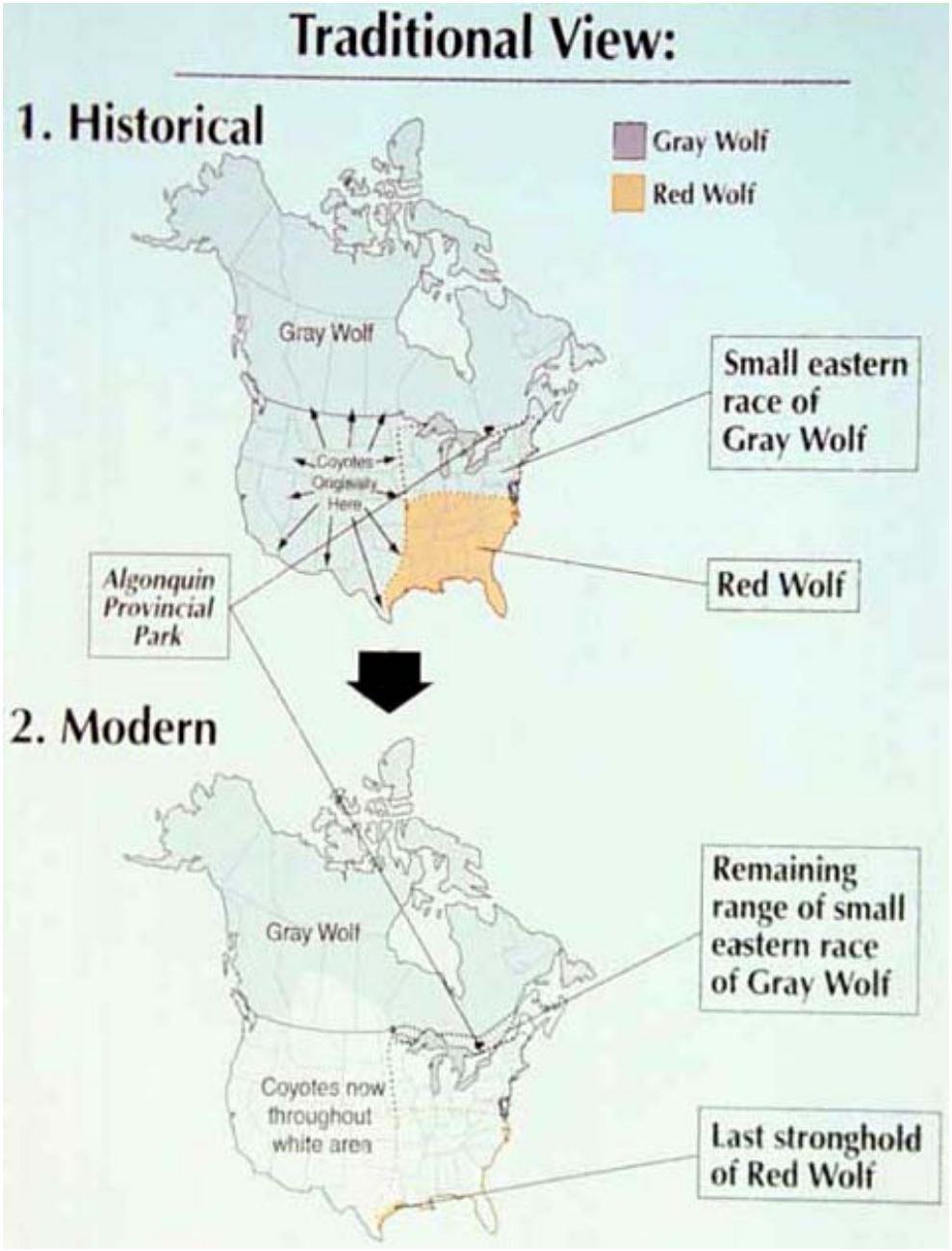
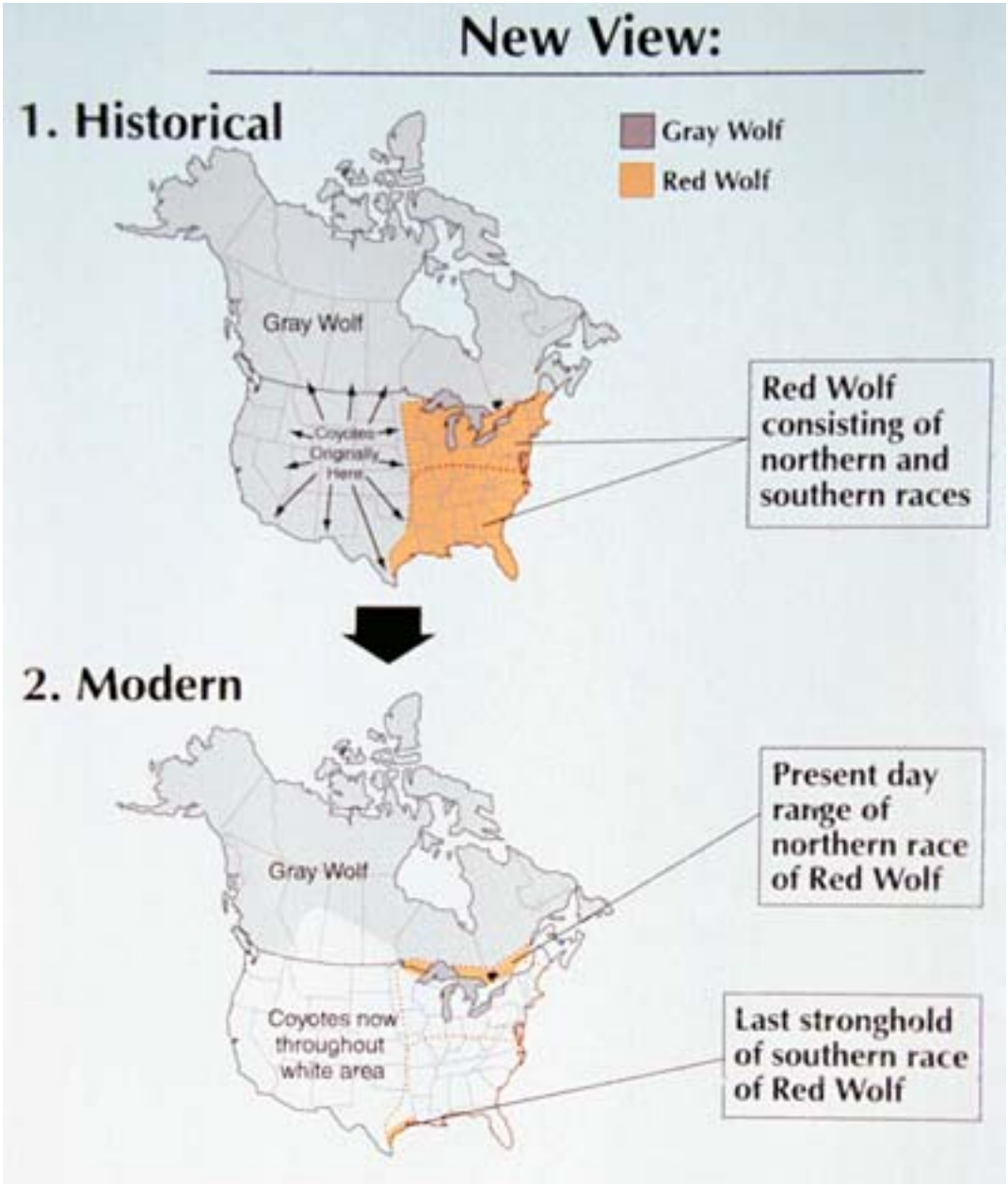

Traditional View:
1. Historical
Gray Wolf
Red Wolf
Gray Wolf
Coyotes Originally Here
Small eastern race of Gray Wolf
Red Wolf
Algonquin Provincial Park
2. Modern
Gray Wolf
Coyotes now throughout white area
Remaining range of small eastern race of Gray Wolf
Last stronghold of Red Wolf

Fig. 4.


New View:
1. Historical
Gray Wolf
Red Wolf
Gray Wolf
Coyotes Originally Here
Red Wolf consisting of northern and southern races
2. Modern
Gray Wolf
Present day range of northern race of Red Wolf
Coyotes now throughout white area
Last stronghold of southern race of Red Wolf