

# Using Bison to Understand Mean Kinship

In this activity students can use information about the Montana National Bison Herd to create a pedigree chart. Your students can then combine this work with information gained from mean kinship value calculations to make management decisions to increase meta-population genetic diversity. Students will engage in science and engineering practices including developing and using models, analyzing and interpreting data and using mathematical thinking to make real-world applied decisions.

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## Objectives:

- Use real-world data to create a bison pedigree chart.
- Analyze and interpret data to understand how genetic information is used to make management decisions, in order that increase meta-population genetic diversity.

## Materials:

- [Bison Conservation Herd Data Set Worksheet](#)
- [Pedigree Chart Foundations](#) document
- Optional: computer access to generate pedigree charts

## Process:

- 1) In this project students will be presented with hypothetical information about a subset of the bison that make up the Montana National Bison Herd, that will allow them to generate a pedigree chart for those herd members. They will also calculate kinship coefficients and mean kinship values. These calculations will allow them to make management suggestions that could increase bison genetic diversity. Students will need prior knowledge in generating and reading pedigree charts to complete this activity.
- 2) The class should view the [Understanding Mean Kinship](#) video to gain real-world context for the complexities of modern bison conservation herd management, and the role that genetic analysis plays in management decisions.
- 3) Teacher should explain to students that today's modern bison herds have arisen from a relatively small founder population that moved through a genetic bottleneck in the early 1900s, when wild bison populations dropped to as few as 1000 individuals nationwide. Today there are roughly 30,000 bison distributed in some 60 conservation herds throughout the country that are managed to ensure that herd genetic diversity is maintained. Teacher should explain to students that by analyzing the pedigree relationships between bison in the Montana herd and making suggestions about which bison's genes are over-represented or under-represented in the population they will use some of the same strategies conservation managers use to manage animal populations for genetic diversity.

- 4) Distribute Montana National Bison Herd Data Set Worksheet to students. Teacher should review the Glossary and the Data Set Worksheet with their students.
- 5) Allow time for students to complete the Worksheet. For calculating mean kinship values the following formulas are used – both are explained in word form on the student worksheet, and examples are provided.

Kinship Coefficient	$k = \sum \left(\frac{1}{2}\right)^n$
Mean Kinship Value for an individual	$mk_i = \frac{\sum_{j=1}^N k_{ij}}{N}$

- 6) After students complete the worksheet, teacher should explain that computer programs such as the freeware program, PMx, or other modeling software programs are used to both calculate mean kinship values and simulate changes in bison herd genetic over many generations representing hundreds of years. In the work that they have done today they were performing a simplified version of this work – in a single generation

**Supplemental Resources:**

There are several online pedigree chart tools available, if you are interested in having your students use these explore the internet for great options!

- a. [Fish and Wildlife Service - National Bison Range](#)
- b. [American Bison Society Working Papers](#)