Module #2: Shark Tooth Classification and Data Collection

Module Overview

In this module, students will learn how qualitative and quantitative data are used by people to classify different objects. We will explore the concept of classification by experimenting with actual fossil shark teeth. Students should first be encouraged to classify the teeth based on their own reasoning, allowing for authentic inquiry. After the students have organized the shark teeth into different categories, we will explore the ways that paleontologists classify fossils to understand why different methods for classification are used to answer specific research questions. Finally, we will see how this data can be organized in a database and address how databases support scientific research.

Driving Question
How do scientists use qualitative and quantitative data to classify objects?

Primary Learning Objectives
- Explain strategies for classifying shark teeth with qualitative and quantitative data.
- Understand how paleontologists classify fossils (e.g., Linnaean Taxonomy).
- Relate tooth shape to specific functions and diets (i.e., structure and function).
- Describe the importance of databases for organizing, storing, and managing data.

Materials
- [Module 2 PPT](#)
- Shark Tooth Kits, consisting of both real fossils and 3D-printed models (*See kit contents at end of document)
- Tooth ID Guide, paper copies to be distributed; file also available in Cohort 2 teacher resources.
- Rulers or Calipers
- Computer
- Microsoft Excel or Google Sheets, both printed out and/or digital

In-class Lesson Guide

Activity 1: Shark Tooth Sorting
- Divide the students into groups of 3-4.
- Provide each group with a shark tooth kit and a ruler or calipers.
- Ask the students to sort the teeth into different categories of their choosing.
- Have the students record what their different categories are and how they were defined. (For example, did you sort the teeth by size, shape, or color).
- Allow each group to present their sorting strategy and discuss what one might learn from their different categories.

Activity 2: Paleontologists' Classification Schemes
- Show the students two different classification schemes used by **paleontologists**.
- The first classification scheme is **Linnaean Taxonomy** (organize the teeth by **species**).

- o   Provide students with copies of the tooth ID guide and allow them to re-sort their teeth into these categories.
- Explain that Linnaean Taxonomy is a classification scheme based on the evolutionary relationships between species.
- The second classification scheme is **Functional Morphology** (organize the teeth based on three functions: cutting, grasping, and crushing).
    - o   These functional groups are also shown on the ID guide.
- Explain that tooth shape relates to specific functions and point out specific features for each tooth function. (Note: recognizing these features will be useful when creating machine learning models)
- Describe how these functions are **adaptations** for feeding on different types of prey.
    - o   Info available on the ID guide.
- Compare the shark tooth functions with the tooth functions in the human jaw (incisors=cut; canines=grasp, and molars=crush/grind). Having multiple tooth functions allows us to feed on a wide variety of food.

Activity 3: Data and Databases
- Have students identify different types of **qualitative** and **quantitative data** that were used in the previously described classification schemes. (Note: this can be derived from the students' sorting strategies and/or from the paleontologists' classification schemes.)
- Have students record specific qualitative characteristics and quantitative measurements of their teeth on the [attached table](#) (Tooth color, Tooth height, Tooth width, etc.), or using a digital spreadsheet (either Excel or Google sheets).
- Explore an existing online **database** to see what kind of information is included.
    - o   https://www.floridamuseum.ufl.edu/vertpaleo-search/
    - o   https://www.myfossil.org/dwc-specimen/
- Make note of the images available in these databases. (Note: This will connect with our next module on Machine Learning.)
- Ask students to describe the importance of these databases. In other words, how can we use these databases and what could we learn from them?
    - o   Databases are used to organize and preserve data. They make information more accessible, so that researchers can utilize it to answer new questions. For example, a paleontologist might ask, where did this species live?

Activity 4: Models in Scientific Inquiry
Models are widely used in science. One of your teeth in the study set is a model of the giant extinct shark, Megalodon. This 3D-printed tooth can be used as a brief activity to understand models.
- Have the students break up into groups and working together, discuss the following questions:
    - ○   How does the 3D printed model of Megalodon differ from an actual fossil tooth?
    - ○   Why do you think that scientists use models to represent the "real thing"?
    - ○   Are there any advantages of models over the real object?
    - ○   Go on-line to sketch-fab and identify and view a model that you would like to download. https://sketchfab.com/3d-models/categories/animals-

pets?date=week&features=downloadable&sort_by=-likeCount