

### The Bio/Diversity Project

Lesson Title: Computer Lab - Hummingbird Data Analysis Pt. 1

Teacher: Grace and Lily

Grade Level: 9th

Lesson Length: 50

This lesson has been adapted from [Pollinators - Hummingbirds](#) and [Our World in Data, Protected Areas](#)

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| <b>AZ Science Standard:</b>   | <ul style="list-style-type: none"> <li>U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Learning Objective:</b>    | <ul style="list-style-type: none"> <li>Students will be able to log into posit.cloud, a platform for using the coding language R, and execute code from a real-world data set.</li> <li>Students will be able to explain how rows and columns organize data.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Scientist of the Week:</b> | <ul style="list-style-type: none"> <li>Deja Perkins</li> <li>Top STEM leader in North Carolina</li> <li>Ph.D. student studying geospatial analytics</li> <li>Perkins is currently investigating the relationship between income and patterns of data collection in urban areas</li> <li>In 2020, she helped launch #BlackBirdersWeek, a social media movement that aims to highlight Black bird watchers, naturalists and outdoor enthusiasts</li> </ul> <div style="text-align: center;">  </div> <p><a href="https://cnr.ncsu.edu/news/2022/02/deja-perkins-recognized/">https://cnr.ncsu.edu/news/2022/02/deja-perkins-recognized/</a></p> |



| Vocabulary                                                                                                                                                             |                            | Materials                                                                                                                                                                                                                                                                                                                                             |                            |                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------|
| <ul style="list-style-type: none"><li>● Geospatial</li><li>● Columns</li><li>● Rows</li><li>● Data Science</li></ul>                                                   |                            | <ul style="list-style-type: none"><li>● Computer Lab Access</li><li>● Computers</li><li>● Posit.cloud accounts<ul style="list-style-type: none"><li>○ <a href="#">Coding lesson</a> (in posit.cloud, but this is a PDF version for reference)</li></ul></li><li>● <a href="#">Slideshow</a></li><li>● Student journals and writing utensils</li></ul> |                            |                               |
| Seasonality: Any                                                                                                                                                       |                            |                                                                                                                                                                                                                                                                                                                                                       |                            |                               |
| <i>Monsoons</i><br>July-Sept.                                                                                                                                          | <i>Autumn</i><br>Oct.-Nov. | <i>Winter</i><br>Dec.- Feb.                                                                                                                                                                                                                                                                                                                           | <i>Spring</i><br>Mar.-Apr. | <i>Dry Summer</i><br>May-June |
| Guiding Questions:                                                                                                                                                     |                            |                                                                                                                                                                                                                                                                                                                                                       |                            |                               |
| <ul style="list-style-type: none"><li>● How do scientists model and analyze data using R?</li><li>● What are the benefits of visualizing data in a computer?</li></ul> |                            |                                                                                                                                                                                                                                                                                                                                                       |                            |                               |

#### Engagement/Introductory Activity:

- Present students with relatable and comical memes about the importance of being resilient and utilizing problem-solving skills while learning how to code for the first time.
- Students can ask questions about computer science, coding, and computer lab expectations during this time.
- Memes:



#### Exploratory Activity:

- Students will be able to model how scientists use computer science to analyze data and answer questions about the world.
- The three parts of Coding Lesson 1 are *Loading The Data*, *Viewing The Data*, and *Counting Hummingbird Sightings*.
- Students will learn to read R comments, run functions, and understand the difference between the Console, Environment, and Terminal in posit.cloud during this lesson.

#### Explain:

- Students will pair up in the computer lab. One of the group members will log into posit.cloud.



- Together, students will follow along to Coding Lesson 1. By the end of class, they will be able to explain how R organizes data with rows and columns and the time the most hummingbirds visited CHS.
- The three columns are labeled Image.number, Path.to.image.in.directory, and Time.stamp.
- Each row holds the above information about one hummingbird image.
- Using the head(), nrow(), and View() functions, students be able to answer the objectives.

**Extension Activity/Questions:**

- In this interactive discussion, students will dive into the concepts of rows and columns within data frames, specifically focusing on the 'hummingbird\_times' dataset used in the R coding lesson. The aim is to understand the basics of data structures in R and the specific applications to our hummingbird sightings.
- Students are encouraged to bring forward any questions or curiosities about R, coding practices, or nuances of the dataset that weren't covered during the standard lesson.
- Additionally, this session will serve as a brainstorming platform for students to propose creative data uses. Ideas could range from predicting future hummingbird visitation patterns analyzing the impact of environmental changes on hummingbird behavior, to integrating the data with other datasets for broader ecological insights. This activity aims to inspire innovative thinking and foster a deeper connection between coding skills and environmental science.

**Evaluation Activity:**

- For this evaluation activity, students will do reflective journaling about what they learned from the coding lesson. This written exercise will prompt students to articulate their understanding of the data structure used in the lesson (rows and columns in the hummingbird\_times dataset) and to reflect on the insights gained from analyzing the data.
- Journal prompts will include the following:
  - Describe what the rows and columns in the hummingbird\_times dataset represent.
  - What does the number of rows in the hummingbird\_times dataset tell us about the presence of hummingbirds at our school?

**The R activity instructions and HTML is listed on the following pages:**



**Posit Cloud Activity Instructions:** [Hummingbird Sightings Analysis HTML Link](#)

### Hummingbird Sightings Analysis

Welcome to our Hummingbird Analysis Project! We're going to find out what time of day hummingbirds like to visit our school campus. We'll use R, a programming language, to look at pictures taken by our wildlife cameras and see when we spotted hummingbirds.

Remember our research question: What time of day do hummingbirds most frequently visit the Catalina High School campus?

### Part 1: Getting Started with R and Our Data

#### Step 1: Loading the Data

First, we need to load our data into R. This data is stored in a file called `valid_timestamps.csv`. You can find it at the bottom right of your screen, where you opened up this file. Each row in this file represents one picture of a hummingbird.

By running the code below, you are reading the data set with all the times hummingbirds were spotted with our cameras. This data came from your hard work sorting photos!

Run your code by pressing the green run button (little green arrow in the top right of the code chunk)!

```
{r}
# This is a comment. It shows up in green. You can also tell it's a comment by the "#" symbol that comes before the
text.
# Comments are ways for us to take notes in our code, for ourselves or other people, without it talking to the
computer.
```

```
hummingbird_times <- read.csv("valid_timestamps.csv")
```

Great! Now we have our data loaded, and we can look at it. See the `hummingbird_times` data frame in the top-right window of your screen.

#### Step 2: Viewing The Data

First, click where it says `hummingbird_times` in the top right portion of your screen. This should open the entire data set. Take a minute to scroll through and get an idea of what the data looks like.

#### Note: 24-hour time

Imagine a day as a big circle. Instead of splitting the circle into two halves (AM and PM), we use the whole circle for the day, starting at 00:00 right after midnight and counting all the way up to 23:59 right before the next midnight.

With the 24-hour clock, we don't need to say "AM" for the morning or "PM" for the afternoon. If it's 15:00, you know it's the afternoon because it's after 12:00, which is lunchtime. Note: 15:00 is equal to 3:00 PM. This time-counting method is called Military Time.



**Discussion / Journal Entry: What do you think the rows and columns represent? What time of day did the most hummingbirds visit CHS?**

Next, let's take a peek at our data using code. The `head()` function lets us look at the first 6 rows of our data. Run the code below to use the `head()` function!

```
{r}  
head(hummingbird_times)
```

As we can see, our data is divided up into rows and columns.

### **Step 3: Counting Hummingbird Sightings**

We can count how many times we saw hummingbirds by counting the number of rows in our data set, because each row is one sighting. If we use `nrow()`, it will tell us how many rows are in our data set!

```
{r}  
nrow(hummingbird_times)
```

**Discussion / Journal Entry: What does the number of rows in the `hummingbird_times` data set tell us about hummingbirds at our school?**