Read Me:

The module in its original design was planned for groups of 3-4 in a three-hour lab period, with short student presentations given at the beginning of the next lab period. The module can be scaled upwards by adding readings and removing restrictions on the type of questions that can be asked. At the same time, instructors can predefine variables and measurements for students to scale the lab down. The google sheet data entry and dashboard tool is designed to accommodate any categorical (two categories) and numerical variables for t-test and correlations. Because of the collaborative nature of google sheets, student groups can come up with several variables and test any combination.

**Preparation for the lab:**

**Materials:**

* Instructors without access to physical specimens have the option of printing out the specimen cards provided **on 8.5 x 11 paper (ONLY)** and organize the specimens by catalog number (the number written on each skull or specimen tag). You may choose to laminate these cards to continue their use for many iterations and applications. In total, there are 172 specimen cards. You will want to divide the cards into packs to distribute among groups (5 per person).
* Alternatively, a specimen image packet for ImageJ is also provided. Instructions coming soon. However, this iteration may likely take additional time to train students how to use ImageJ
* Rulers
* Printouts of the lab and data collection sheet.
* Instructor will need a google account (free) and copy the dashboard tool into their own drive. Students do not need a google drive account. This can be done by selecting “File” and “Make a copy”
  + Make sure to make a Results dashboard for each group. This can be done by right clicking the Results Dashboard tab and selecting “duplicate”. Each group should claim a dashboard by renaming subsequent dashboard tabs with a team name. Manipulating one results dashboard will not affect the others.
* Projector and computer
* Student computers. Although students may collect data on their worksheets and enter their data into a single computer if a set of laptops is not available

**Notes:**

It is important that instructors test out the Google sheet tool before implementing it with students and demo its use at some point in the lab. The Google sheet tool has been through over 40 sections of freshman laboratories to identify and work out bugs. However, if the tool does some how break, please email [mzhuang@utep.edu](mailto:mzhuang@utep.edu) for assistance.

For those that may be interested in using the tool in modified adaptations, it is important to know that the tool **only** works for questions that have one independent variable (a categorical with 2 categories or numerical variable) and one dependent numerical variable. Due to limitations in how google sheets works, both the bar graph and scatter plots will show and students have to choose which graph is most appropriate. A design of the tool where students choose the appropriate graph to display is in development. However, it currently requires that students have their own google drive account and be signed in. If you’re interested in this iteration, please email [mzhuang@utep.edu](mailto:mzhuang@utep.edu).

In working with the images from real specimens, instructors should discuss the following before the class either at the beginning of the lab or in a lecture before the lab:

* The importance of measuring consistently
* The importance of defining methods and variables (from what landmark should a length be measured). If you measure on the left side of the skull, you need to continue doing so because measurements on the left side may be different than from the right.
* The importance of collaboration. Samples may be shared among the class if printed out. If students need to measure the same sample, they may need to wait their turn, mimicking real world research issues. If the lab is conducted remotely, they may ask each other to take measurements for each other.
* The imperfection in samples. All samples of the UTEP-BC rock pocket mice have been provided, including those that may be broken. Students will need to evaluate if a sample is suitable for their question.
* The need to wrestle with the uncertainty of what variables to measure. This is not a cookbook lab and there is no known answer beforehand.

As students start to brainstorm and develop their traits, instructors should circulate around the class to guide the development of the variable definitions and what traits may or may not be appropriate to measure. At the end of the brainstorming session, instructors should gather the traits determined by each group and may want to discuss these traits to avoid duplication. The instructor can then enter in all the trait names and enter them into the first header row of the data entry sheet.

Instructors will also need to demonstrate how to make conversions for measurements on images. For any measurement taken on the blown up skull images, students will need to multiply the measurement by 0.24 to get the actual measurement in mm. **This is assuming that specimen cards are printed on 8.5 x 11 paper!**

When students are ready to present, instructors only need to display the google sheet on the projector screen and switch to the appropriate Results Dashboard tab.