

# Nature or Nurture? Heritability in the Classroom - Teacher Packet

By Layla Hiramatsu and Theodore Garland, Jr., Ph.D.

University of California, Riverside

## Create Google Form

1. Open web browser, type in URL: forms.google.com.
2. Log in to your Google account.
3. You will see a screen like this:

4. Add questions as appropriate. You can also change the theme. (To view example questions used, see next page or follow link below.)
  - a. Use short "variable names" for **Question Titles**, such as heightyou, heightmom, heightdad. Do not use any spaces, parentheses, pound signs, etc. in these variable names.
  - b. Use the **Help Text** box to enter descriptive information about what the value will represent, such as "How tall are you?" or "How much do you like salty snacks, such as potato chips or peanuts?" This information will not appear in the Google spreadsheet that contains the responses.
5. When ready to send to students, click "Send Form" on the upper right corner. You can copy and paste the URL, or email students the form directly.

An example of a Google form that we have used can be found here:

<http://docs.google.com/forms/d/16PePIsf4nK3n56rbQkIw6Q0iG1Y9ItQKHqY0vzo5NYU/viewform?c=0&w=1>

Short URL: <http://goo.gl/forms/yQii8JbI3C>

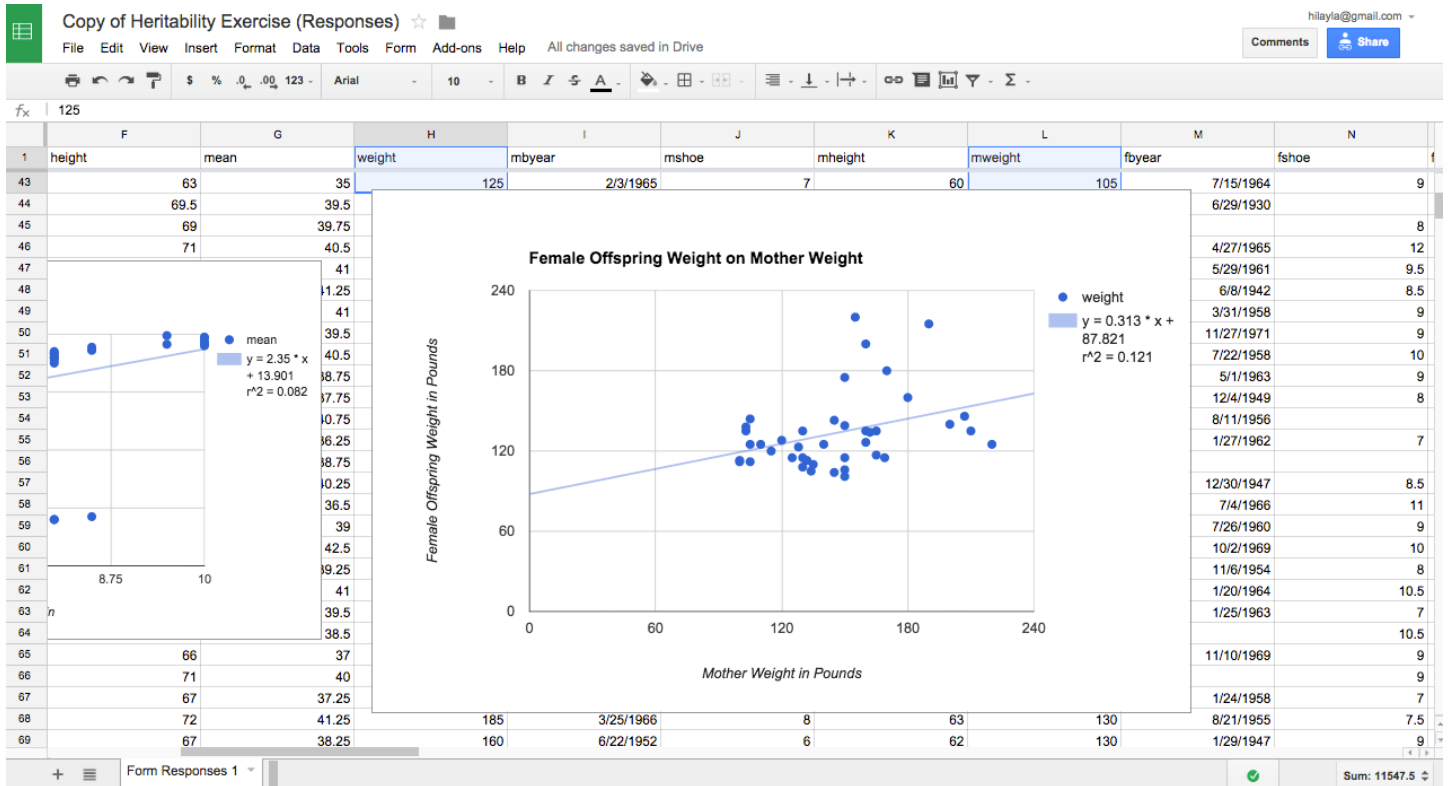
## Analyze Data in Google Drive Spreadsheet

(the next version will include a link to a sample data set so teachers can practice these instructions)

1. Go to File, Make a Copy, and enter a new document name. This will protect the original data from disasters.
2. Check for obvious data formatting errors, such as height entered as 5'8" rather than 68. Either correct these values or delete them. **This step is absolutely crucial!**
3. Again, Make a Copy, and give it a new name. The point is to avoid ever overwriting your original data file!
4. Add midparent "average parental values" ("midparent" is just jargon for the average of the two parents):
  - i. Create new column by right clicking on a column letter and "Insert 1 left"
  - ii. In the first row, type "=AVERAGE(", click on first parental value, then type a comma, then click on second parental value, type ), then hit enter.
  - iii. Click and drag down to the last row.
  - iv. Average - if missing value or value is in wrong format, the equation only takes the valid value. This is why it is crucial to correct the data beforehand, see #2.
5. Separate sexes:
  - i. Click on sex (Male/Female) column, click on column letter to select entire column.
  - ii. Select dropdown arrow on the column letter, Sort sheet A->Z
  - iii. Alternatively, you may want to save two copies of the data file, one with each sex, and named appropriately.
6. Select columns to create a chart
  - i. Go to the column of interest variable (x-axis)
  - ii. Scroll down to bottom of Females, then select from last female, drag mouse to top of column.
  - iii. Scroll back down to the last female, then scroll sideways to your y variable. While holding down the Ctrl key, click on the last female in the y variable and drag up to the top of the column.
  - iv. You should now have two columns highlighted.
7. Insert scatter chart
  - i. Click on Insert, Insert Chart, click chart tab, select scatter, click scatter chart to highlight (top)
  - ii. Click on Customize tab, type in informative Chart Title, such as "Body weight in inches" (you can see update in real time on the right)
  - iii. Scroll down in Customize tab, type Axis title, horizontal, e.g., "mother's weight"
  - iv. Axis dropdown menu, switch to Left vertical axis, type in title, e.g., "Offspring weight"
  - v. Scroll down in customize tab, add trendline, select Linear.
  - vi. Next dropdown menu for Label, select "Use equation"
  - vii. Click on Show R<sup>2</sup> box.
  - viii. Click on Insert on the bottom left.

Note: You may have to search for the chart. It will be where you last clicked in the spreadsheet. Drag chart to convenient place
8. Edit Trendline (if necessary):
  - i. Click on a data point. right most logo > Trendline > linear
  - ii. Click on new trendline, click on R<sup>2</sup>,
  - iii. Right click on trendline, click advanced edit.
  - iv. Under customize tab, scroll to bottom. Under Label, click "Use Equation", click Update.

Your graph should look something like the following:



9. Note that the equation will look something like the following:

$$y = \text{slope} * x + Y\text{-intercept}$$

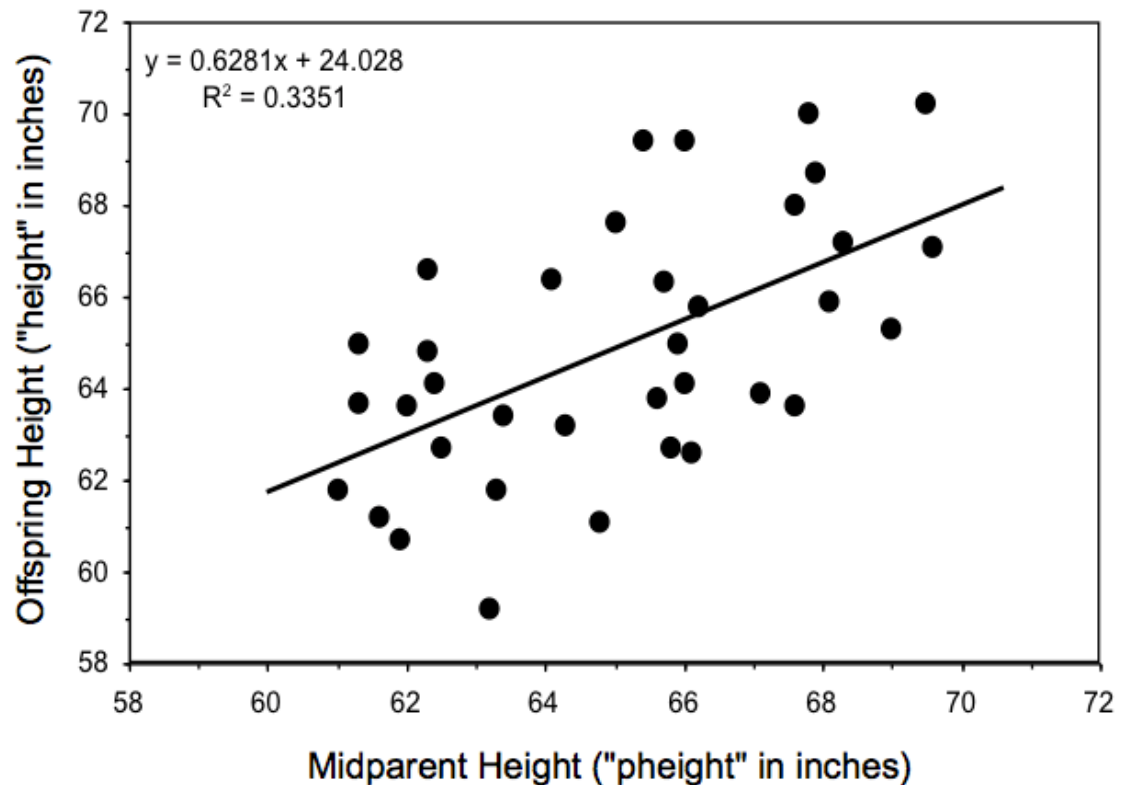
10. The slope of the offspring regressed on the **average of the two parents** is the estimate of the narrow-sense heritability.

## Example of Data Gathered by Students – Height and Exercise Frequency

These data are representative of that which can be gathered in a college course. They do not represent actual values from students, but instead have been created to resemble the patterns we have gathered from a college class. The plot shows the offspring-on-midparent regression of height. The data for this plot are in the table on the left. Midparent values are averaged from mothers and fathers.

The equation of the regression line is on the top left corner of the plot, along with the coefficient of determination  $R^2$  (the percentage of variance in the y-variable that can be predicted by variance in the x-variable). The slope of the regression, 0.6281, is the estimated narrow-sense heritability or  $h^2$ . A statistical test would indicate that this slope differs "significantly" from zero.

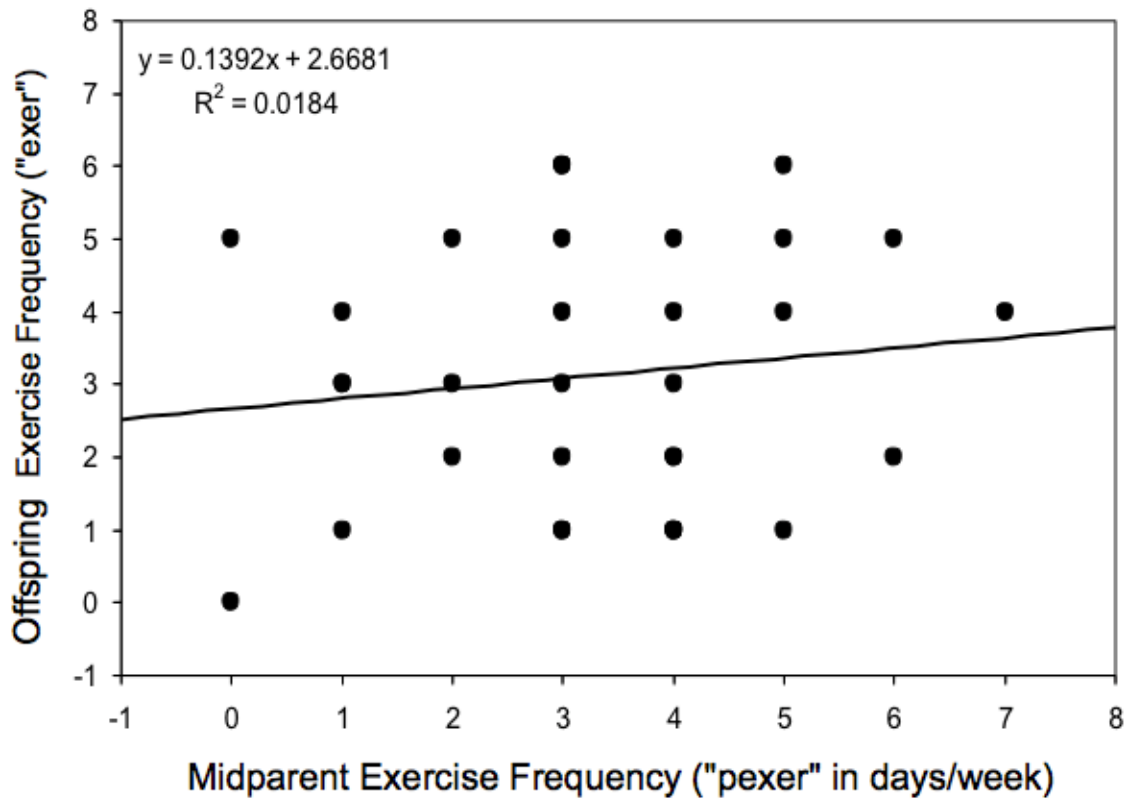
Midparent Height (in)	Offspring Height (in)
65.8	62.7
67.9	68.7
67.6	63.6
62.5	62.7
61	61.8
64.8	61.1
68.3	67.2
64.1	66.4
65.9	65
66.1	62.6
67.8	70
66	69.4
63.4	63.4
65.7	66.3
67.6	68
62.3	66.6
63.2	59.2
65.4	69.4
68.1	65.9
61.6	61.2
66	64.1
65.6	63.8
66.2	65.8
62	63.6
65	67.6
61.9	60.7
69	65.3
69.5	70.2
67.1	63.9
61.3	65
63.3	61.8
62.3	64.8
62.4	64.1
61.3	63.7
69.6	67.1
64.3	63.2



The plot shows the offspring-on-midparent regression of exercise frequency (measured in days per week). The data for this plot are in the table on the left. Midparent values are averaged from mothers and fathers. Missing values represent missing data, which may happen if a student could not get information from either biological parent.

The equation of the regression line is on the top left corner of the plot, along with the coefficient of determination  $R^2$  (the percentage of variance in the y-variable that can be predicted by variance in the x-variable). The slope of the regression, 0.1392, is the estimated narrow-sense heritability or  $h^2$ . However, as you can see by the plot, and  $R^2$ , there is a lot of variability around the line, indicating that the heritability estimate is not statistically significantly different from zero. In other words, we do not have any strong evidence that exercise frequency is heritable in this population.

Midparent Exercise Frequency	Offspring Exercise Frequency
	1
2	5
3	1
4	1
	1
	4
4	1
3	4
1	3
4	2
4	1
3	6
2	3
6	2
3	2
3	5
1	4
4	2
5	1
3	1
2	2
1	3
5	4
5	5
7	4
4	5
4	3
0	5
3	6
	1
1	1
6	5
5	6
3	3
4	4



# Heritability Exercise

## **Instructions for Report** (as used in an upper-division, college undergraduate course)

Your report must be no more than \_\_\_ page(s). Make sure to answer each question listed under each of the six sections. Points will be deducted for spelling errors, poor grammar and sentence structure, etc. Your report must be typed. Points will be deducted if your report is turned in late.

### 1. Introduction:

What is narrow-sense heritability? Why do researchers estimate this metric (i.e., why is it important or relevant)?

Choose and state three of the traits that your class measured and analyzed to consider in more detail.

What kind of traits are they (morphological, physiological or behavioral)?

Discuss the three traits and explain why they are of interest from one or more perspectives.

State your hypotheses. Which of your three traits do you expect to have higher or lower narrow-sense heritability estimates? Why?

Do you expect any relationships/correlations between the three traits? For example, one might expect preference for sweet foods to be positively related to body weight (after adjusting for body height).

### 2. Methods:

How were the data collected? Was the information self-reported or measured? How did we deal with obvious mistakes in the data file and any outliers?

How did we analyze the data, once collected and "cleaned" of obvious or apparent errors? Specifically, for each of your three traits, which additional traits (covariates), if any, did we include in the statistical analysis? Why did we adjust (control statistically) for other traits, such as age?

### 3. Results:

Briefly describe the results for your three traits. Include the offspring-on-parent regression graphs for each of the traits you include. How did the graphs look? Include the heritability estimates and, if available, tests of whether the estimates differ statistically (significantly) from zero.

### 4. Discussion:

What are some other factors that could have affected the results you obtained? Can you think of ways to improve the collection or analysis of these kinds of data?

### 5. Conclusion:

Of the three traits you chose to consider, which ones were heritable? Did the level of heritability match your predictions for different types of traits?

### 6. Feedback:

How did you like this heritability exercise? Did you learn something new? What would you like to see added or modified?