Doing Science : from Start to Finish (day 4)

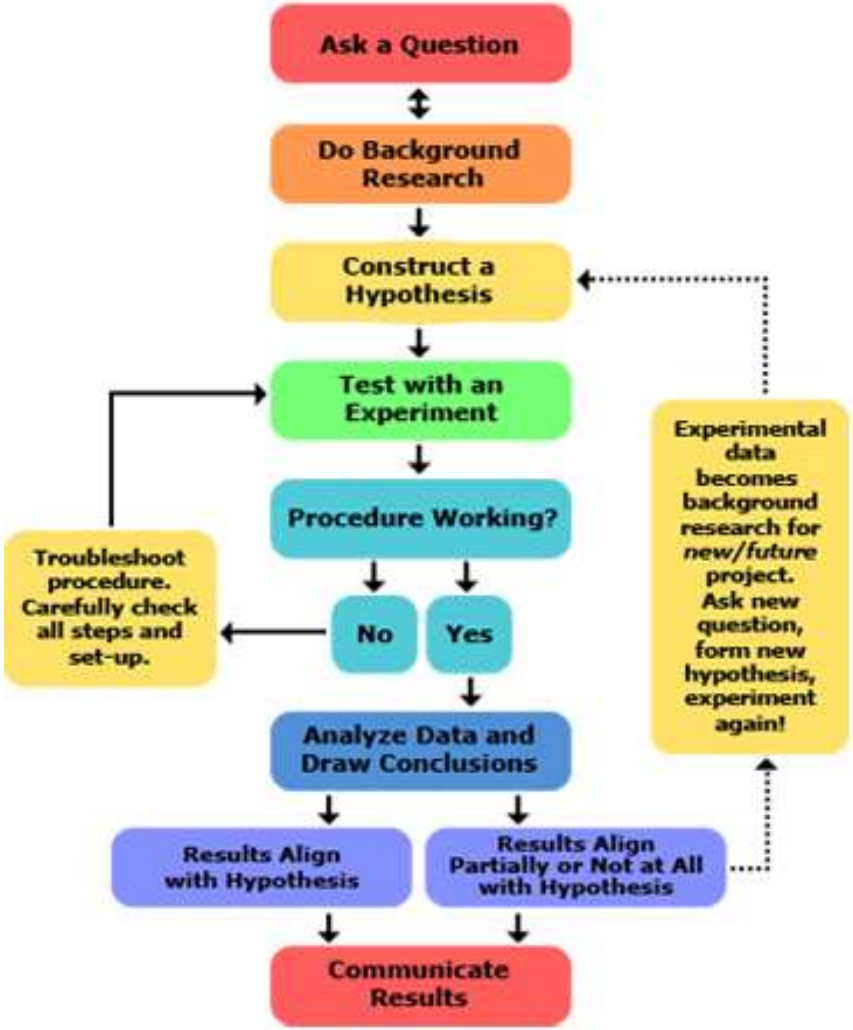
Dr. Félix E. Rivera-Mariani

https://github.com/friveramariani/DoingScienceWorkshops

Today’s goals

- Differentiate between good and poor structures in questions, hypothesis, and purpose
- Designing questions and hypotheses from existing data
- Implement questions related to the epicycle of data analysis
- Familiarize with the type of data and format for properly gathering data

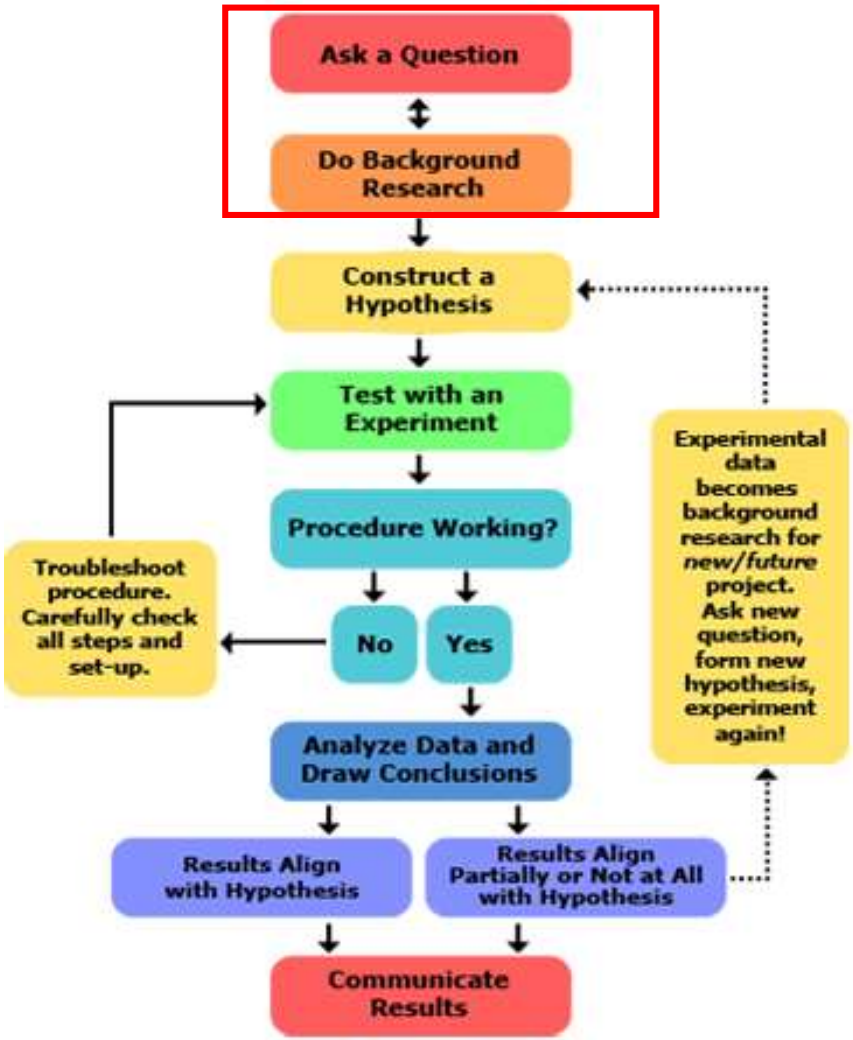
The Scientific Method: Review



http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

- Two directions between question and background research
- Epicycles with the experiment
- Epicycle between results and hypothesis

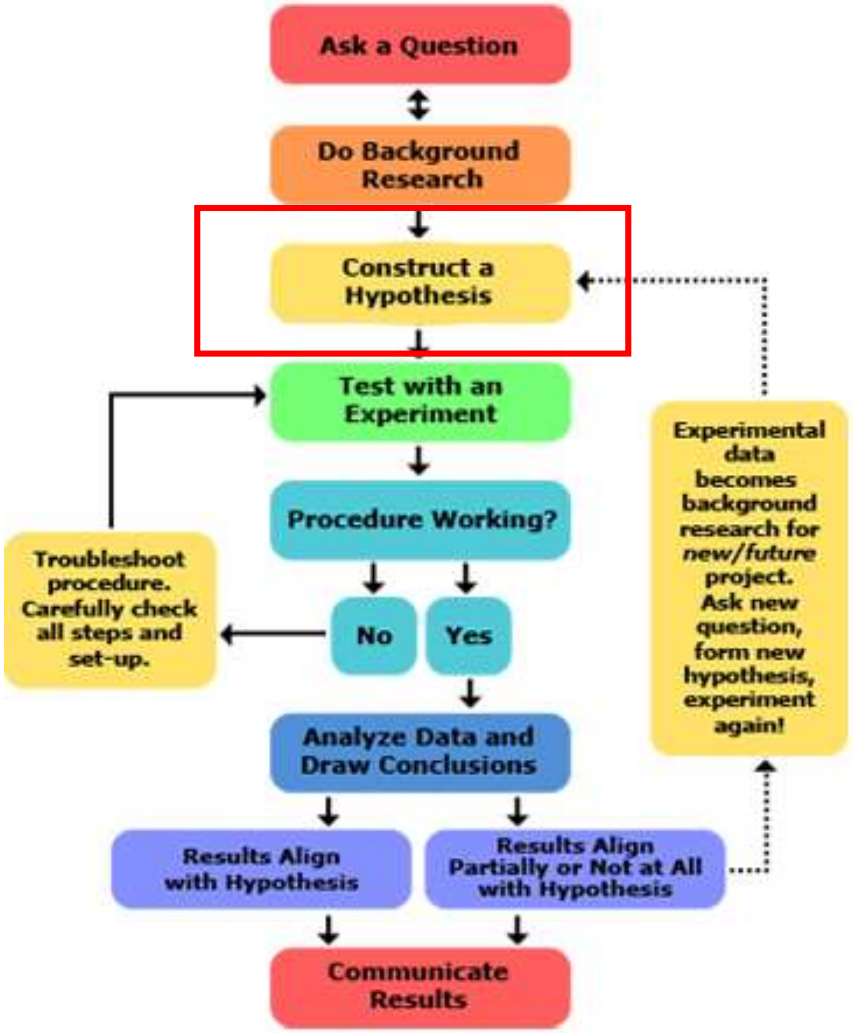
The Scientific Method: *The question*



http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

- What are the most frequent words in the students expectations' about the workshop *"Doing Science: from Start to Finish"*?

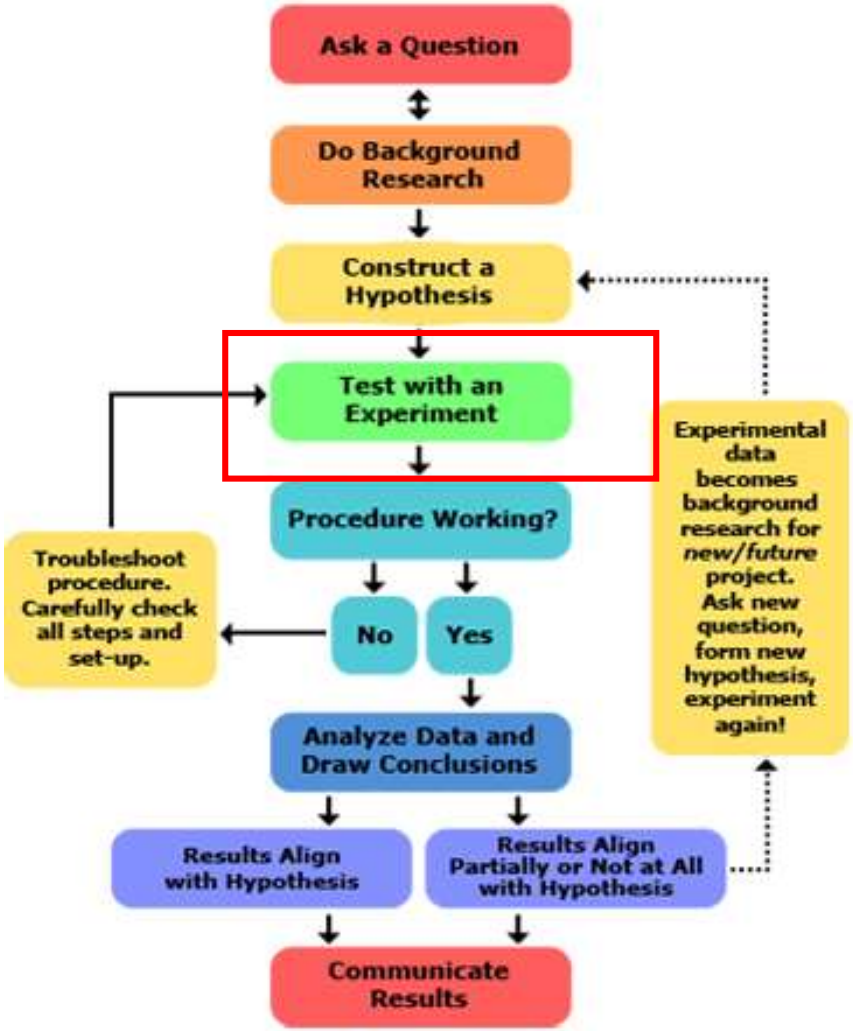
The Scientific Method: *The Hypothesis*

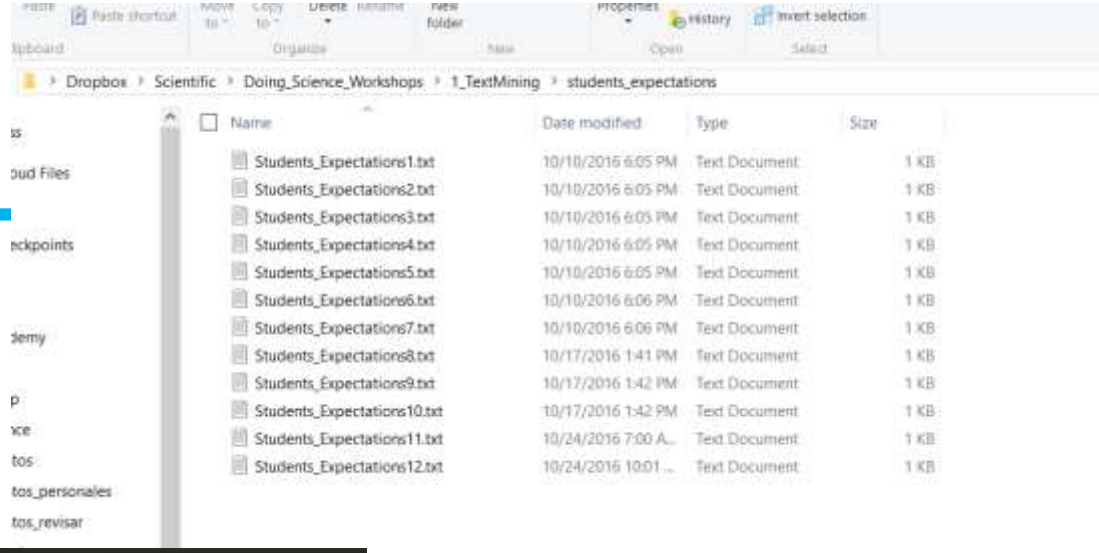


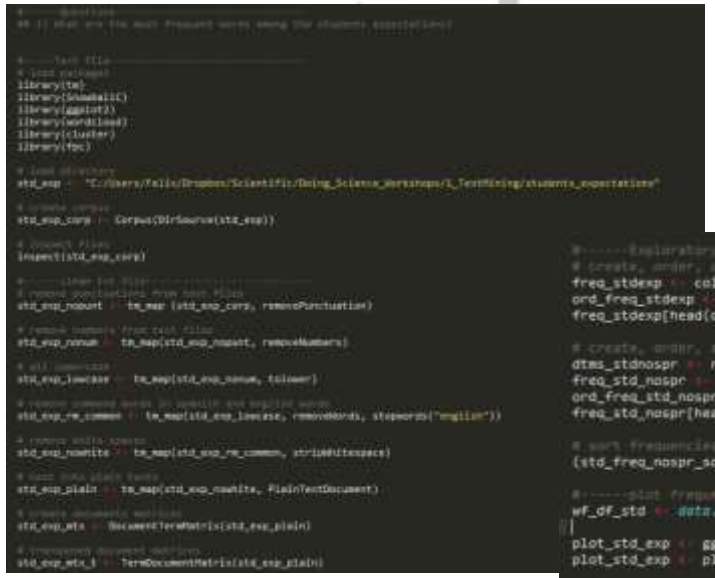
http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

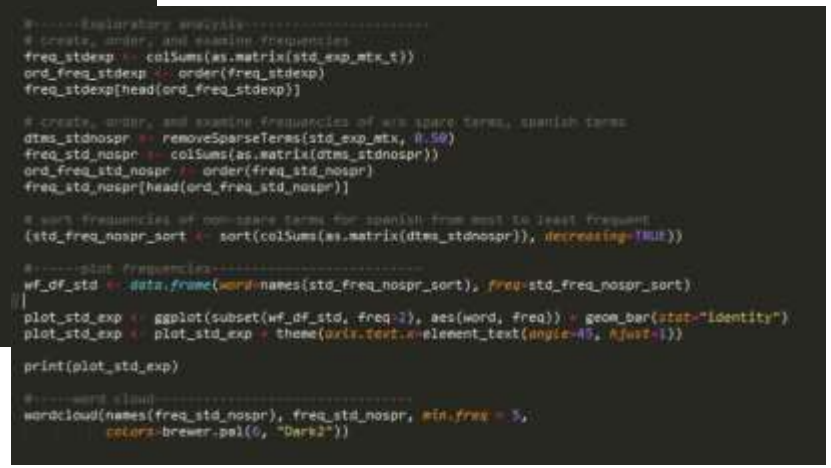
The students expectations' of the Doing Science workshop will contain words that are in the title of the workshop.

The Scientific Method



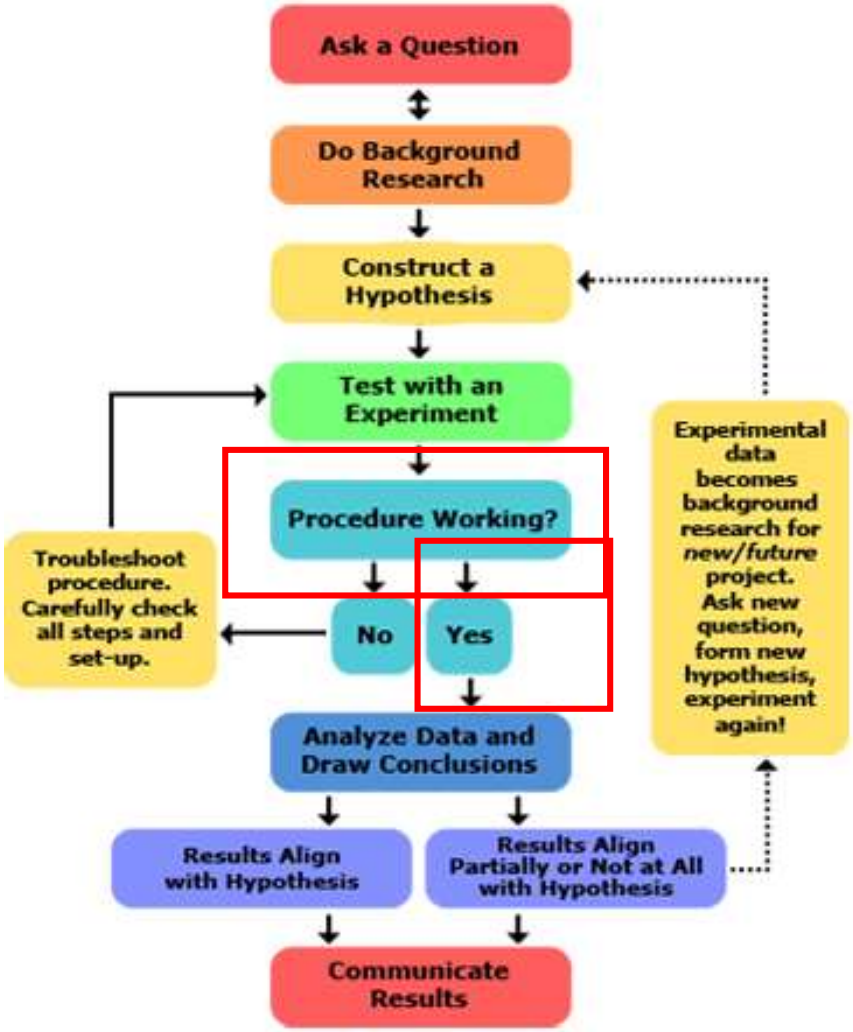


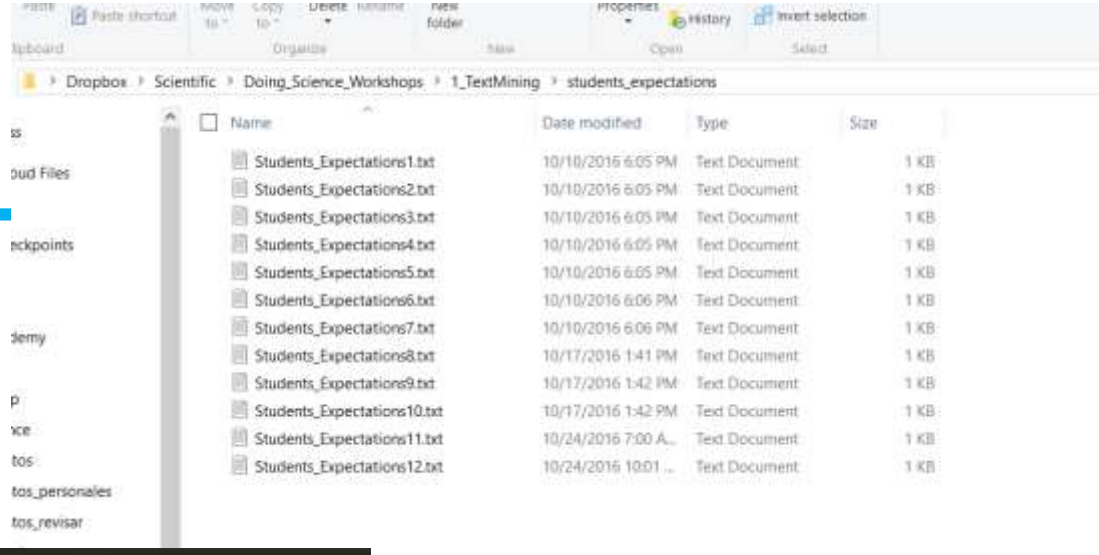


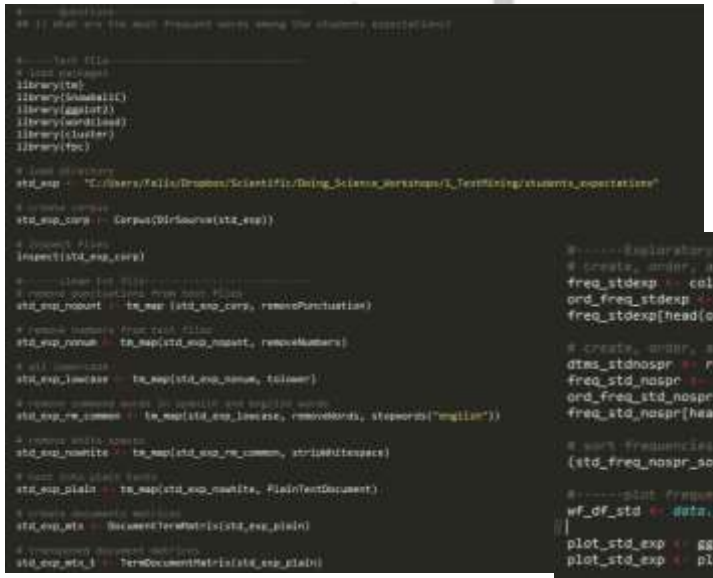


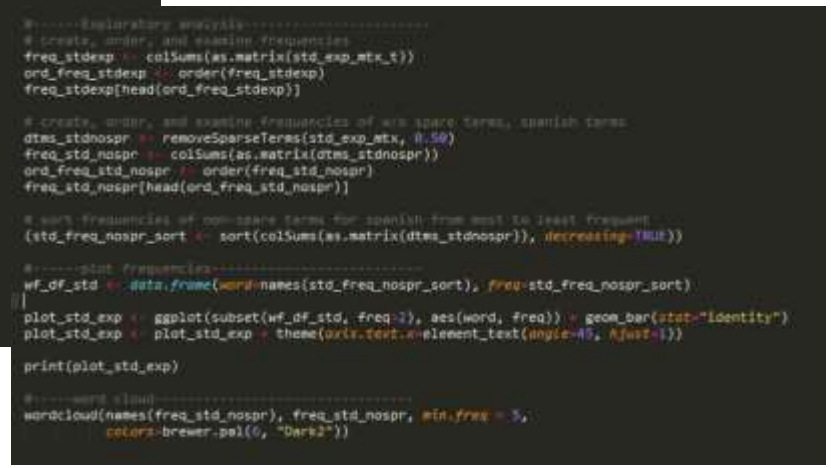
http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

The Scientific Method



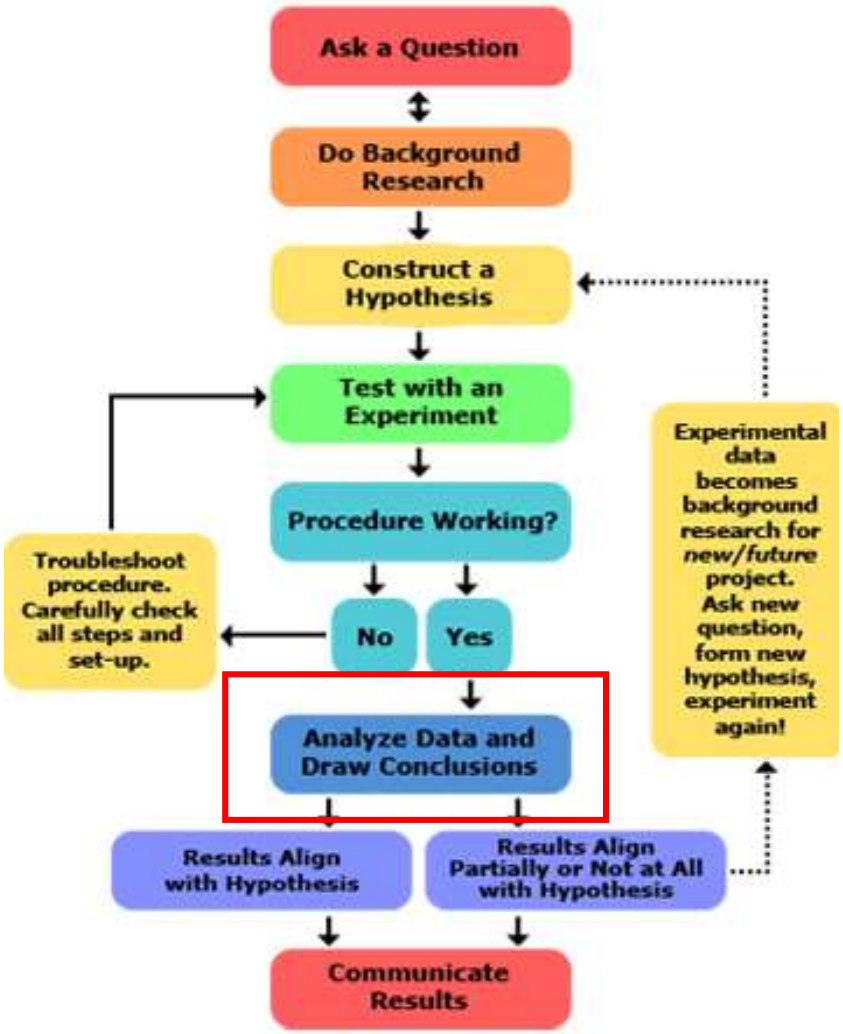


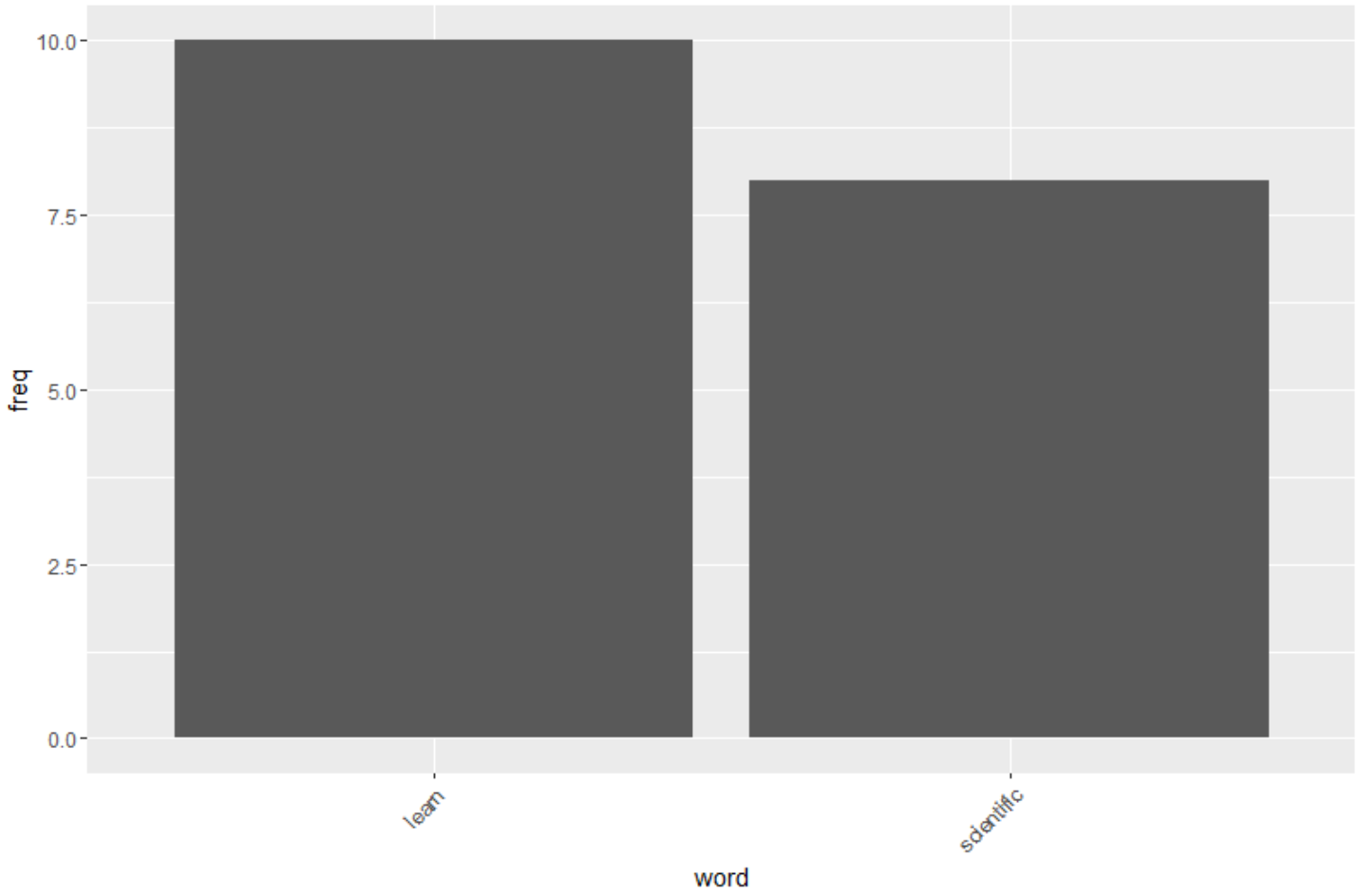




http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

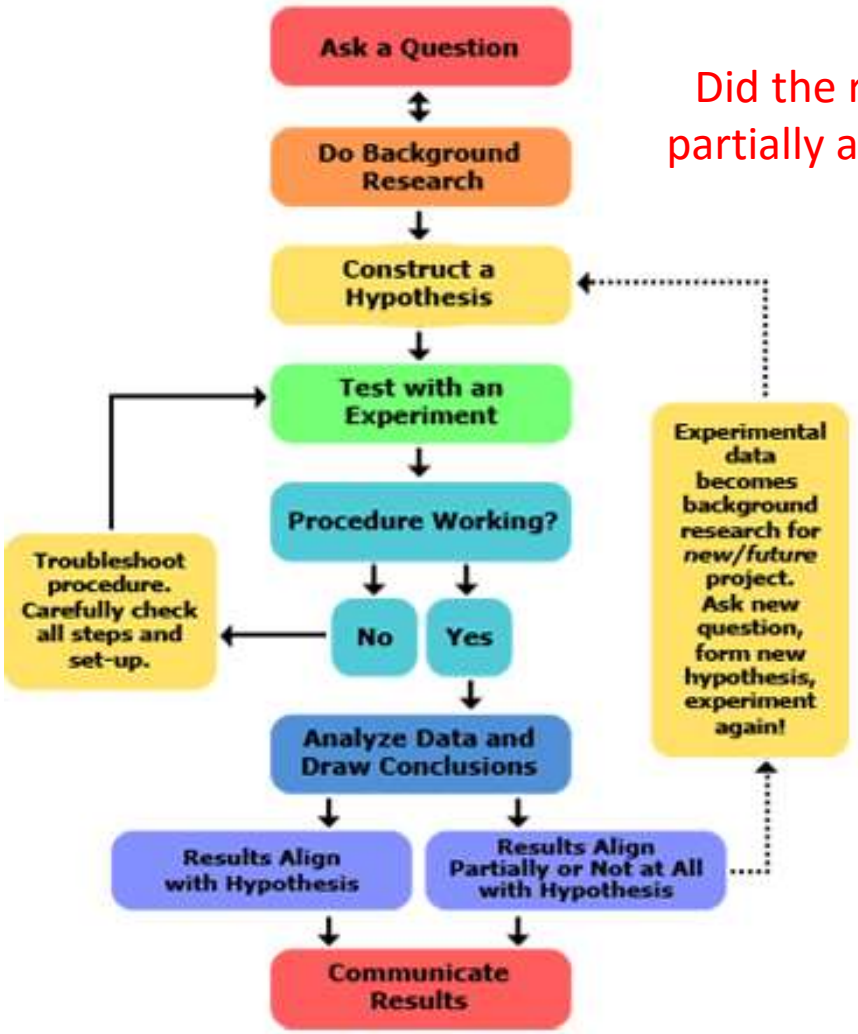
The Scientific Method: *The Results*





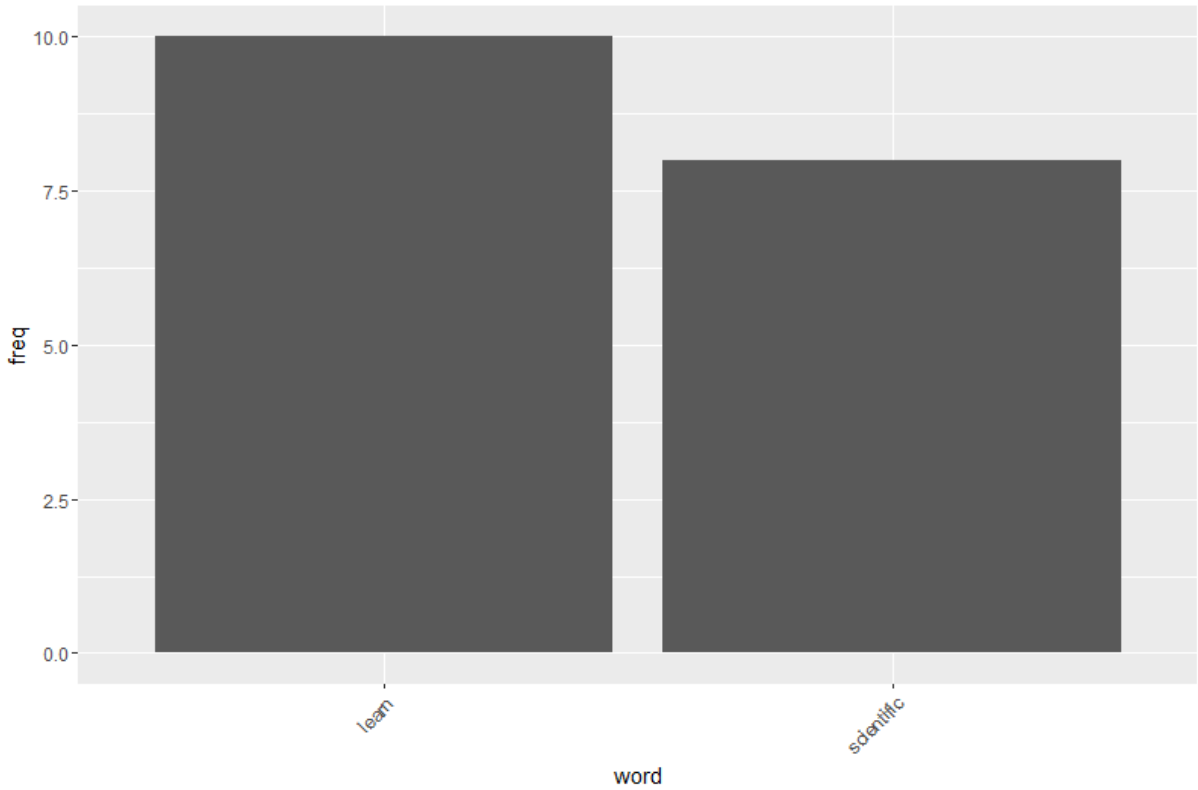
http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

The Scientific Method: *Align or partially align?*



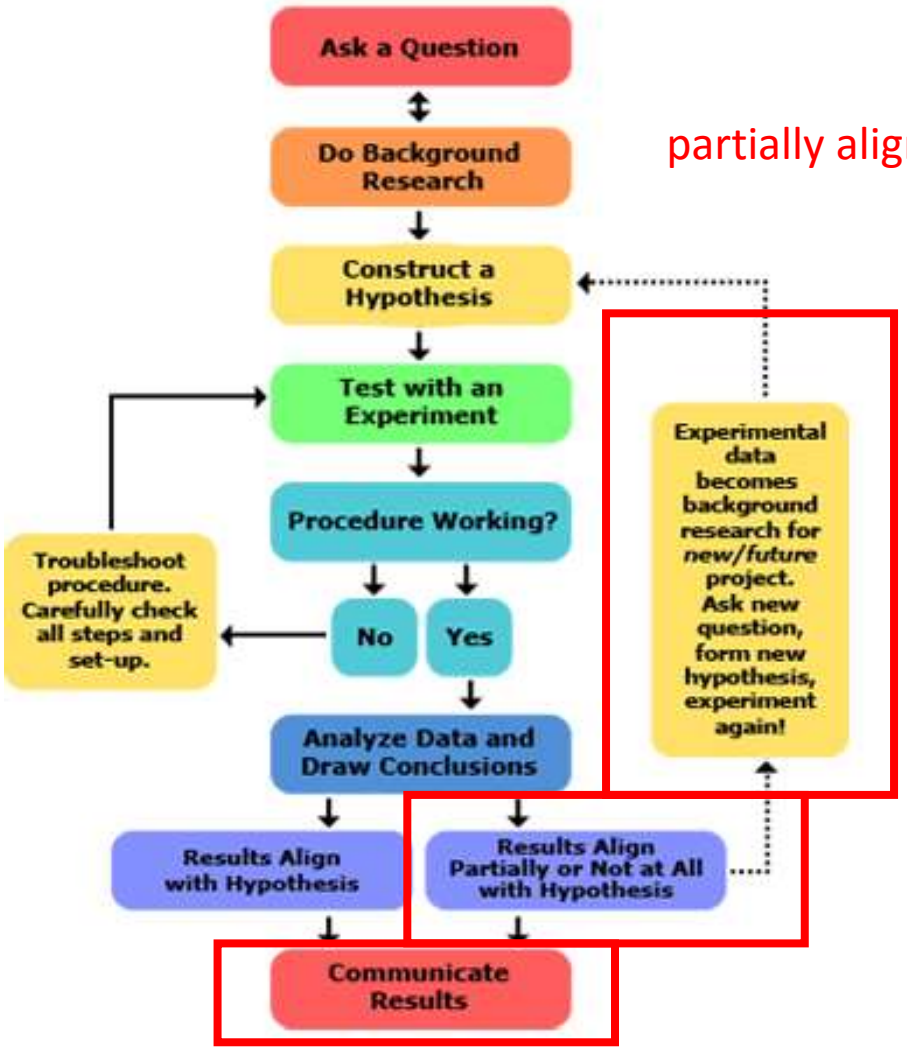
Did the results align, partially align, or not at all?

Hypothesis: The students expectations' of the Doing Science workshop will contain words that are in the title of the workshop.



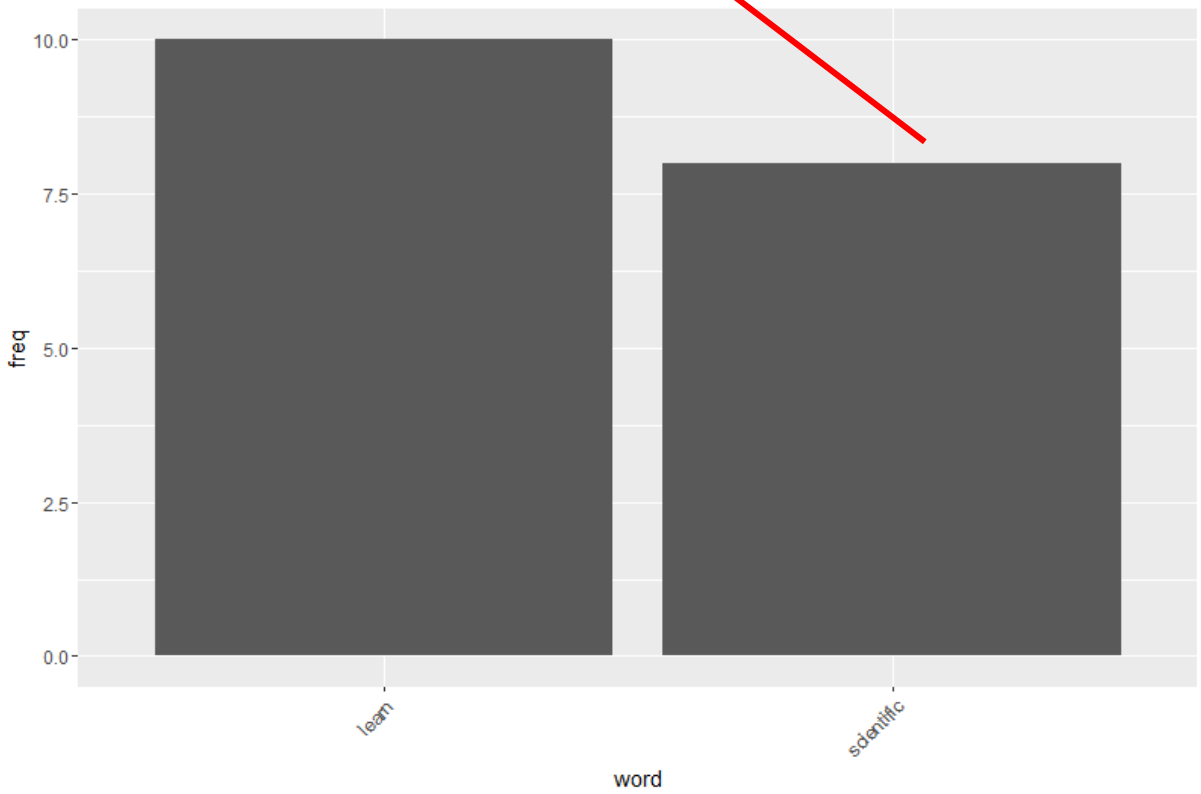
http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process

The Scientific Method: *partially align*



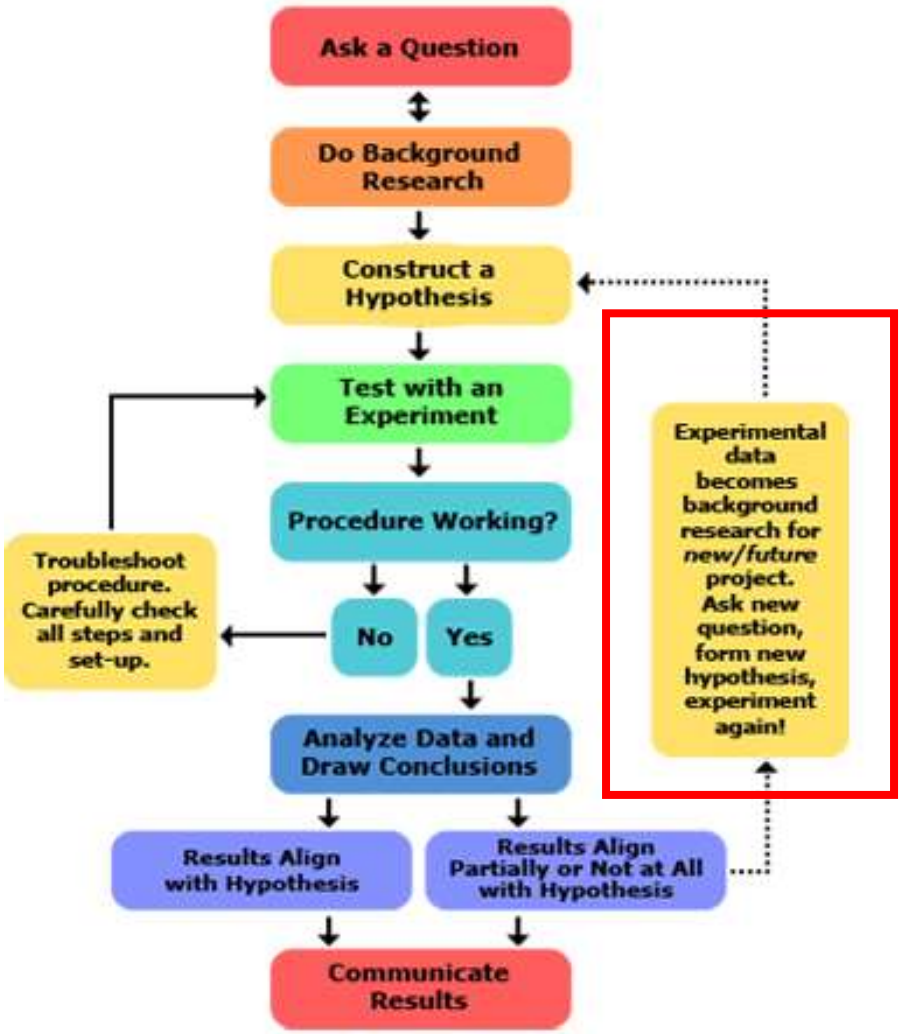
partially align

Hypothesis: The students expectations' of the Doing **Science** workshop will contain words that are in the title of the workshop.



http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process

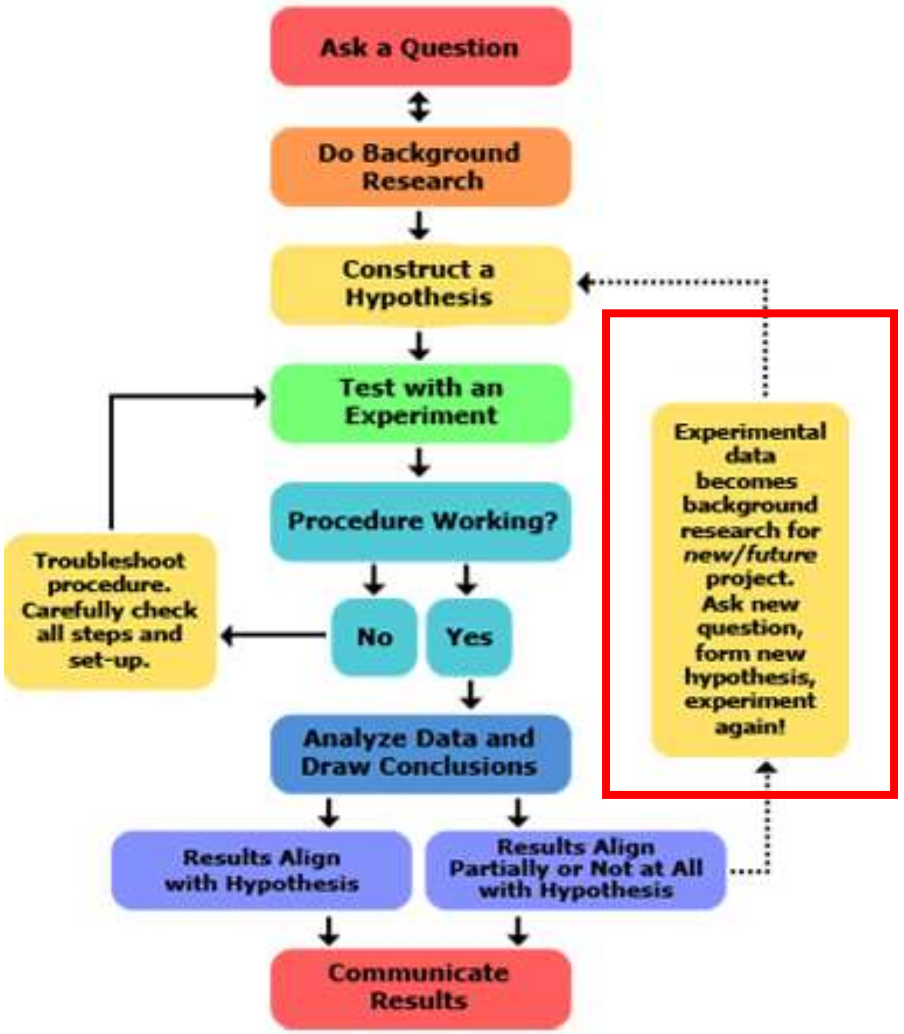
The Scientific Method: *new question(s)*



http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

If each of you sent a hypothesis, and then resubmitted a new hypothesis, *what could be a question that may have originated from our experiment about student's expectations*?

The Scientific Method: *good questions?*



http://www.sciencebuddies.org/blog/2013/09/understanding-the-engineering-design-process.php

a) Will the students' hypothesis 1 and hypothesis 2 align with the results of the students expectations' results?

b) Will students hypotheses (hypothesis 1 vs hypothesis 2) share commo words?

c) Will students' hypothesis 1 have higher number of letters than hypothesis 2?

d) Will students' hypothesis 2 be better than hypothesis 1?

The Scientific Method: *good questions?*

Meet the criteria:

1. Specific
2. Testable

a) ~~Will the students' hypothesis 1 and hypothesis 2 align with the results of the students expectations' results?~~

b) Will students hypotheses (hypothesis 1 vs hypothesis 2) share commo words?

c) Will students' hypothesis 1 have higher number of letters than hypothesis 2?

d) ~~Will students' hypothesis 2 be better than hypothesis 1?~~

The Scientific Method: *hypothesis from the question*

Using the **<u>same words</u>** used already in these two questions, design a hypothesis for each question

b) Will students hypotheses (hypothesis 1 vs hypothesis 2) share commo words?

c) Will students' hypothesis 1 have higher number of letters than hypothesis 2?

The Scientific Method: *hypothesis from the question*

Using the **same words** used already in these two questions, design a hypothesis for each question

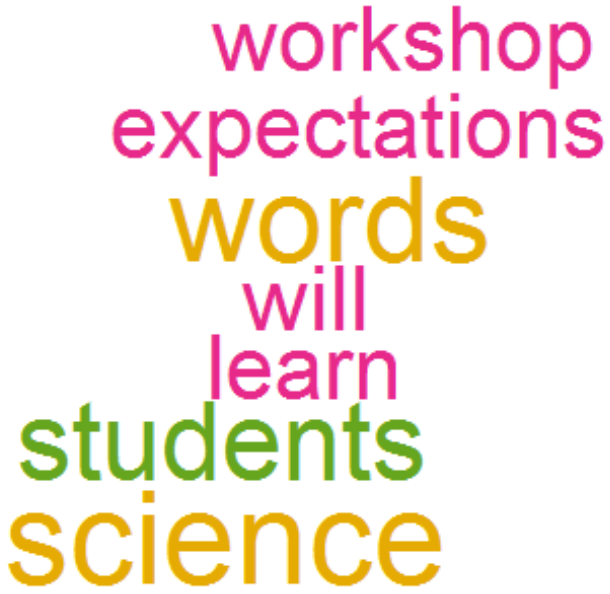
b) Students' hypothesis 1 vs hypothesis 2 **will** share commo words.

c) Students' hypothesis 1 **will** have higher number of letters than hypothesis 2.

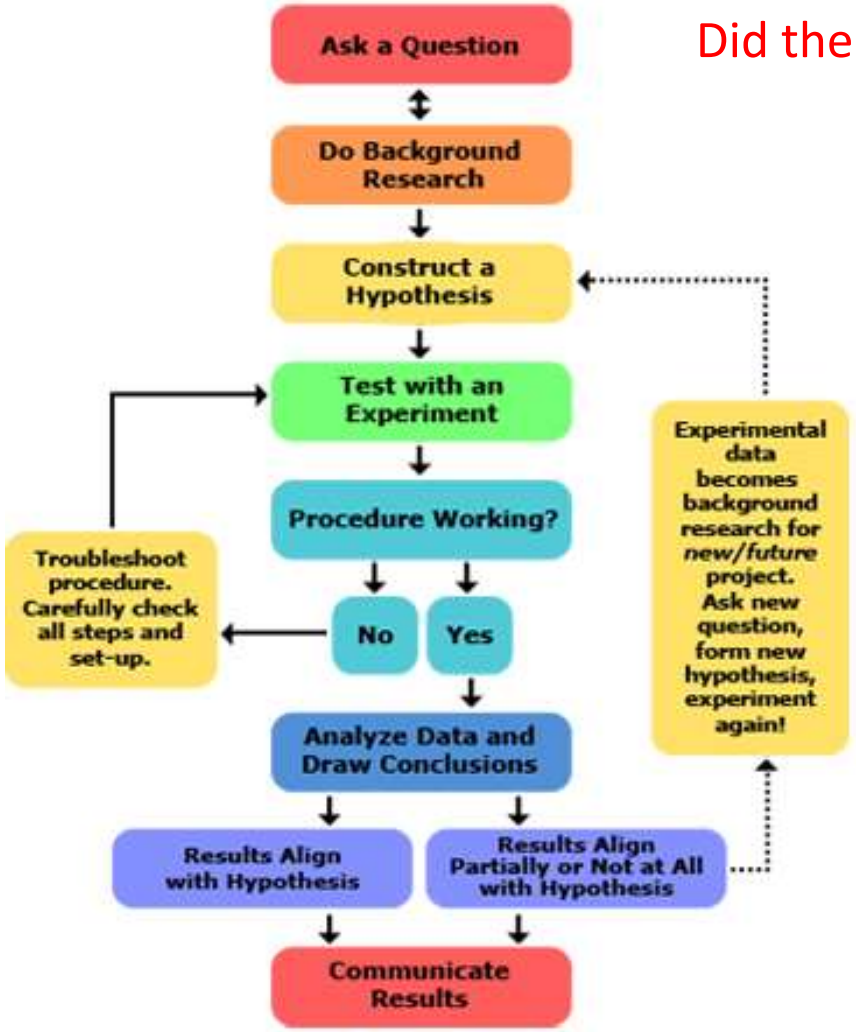
Students' hypothesis 1 vs hypothesis 2 **will** share commo words.

Common words in hypothesis 1

Common words in hypothesis 2



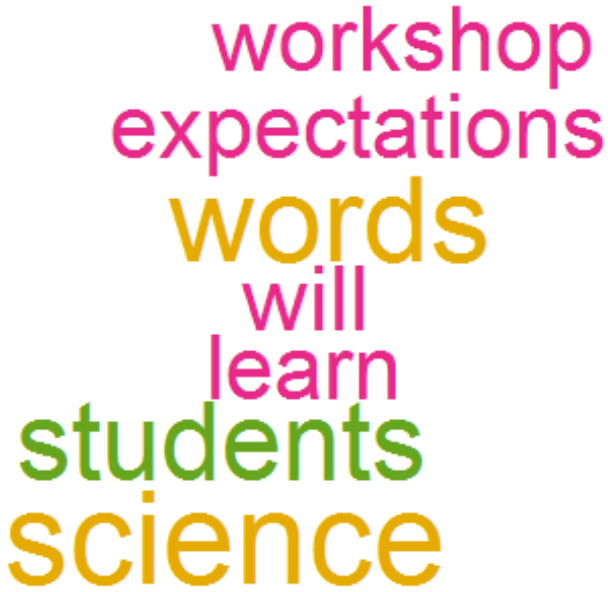
Students' hypothesis 1 vs hypothesis 2 **will** share commo words.



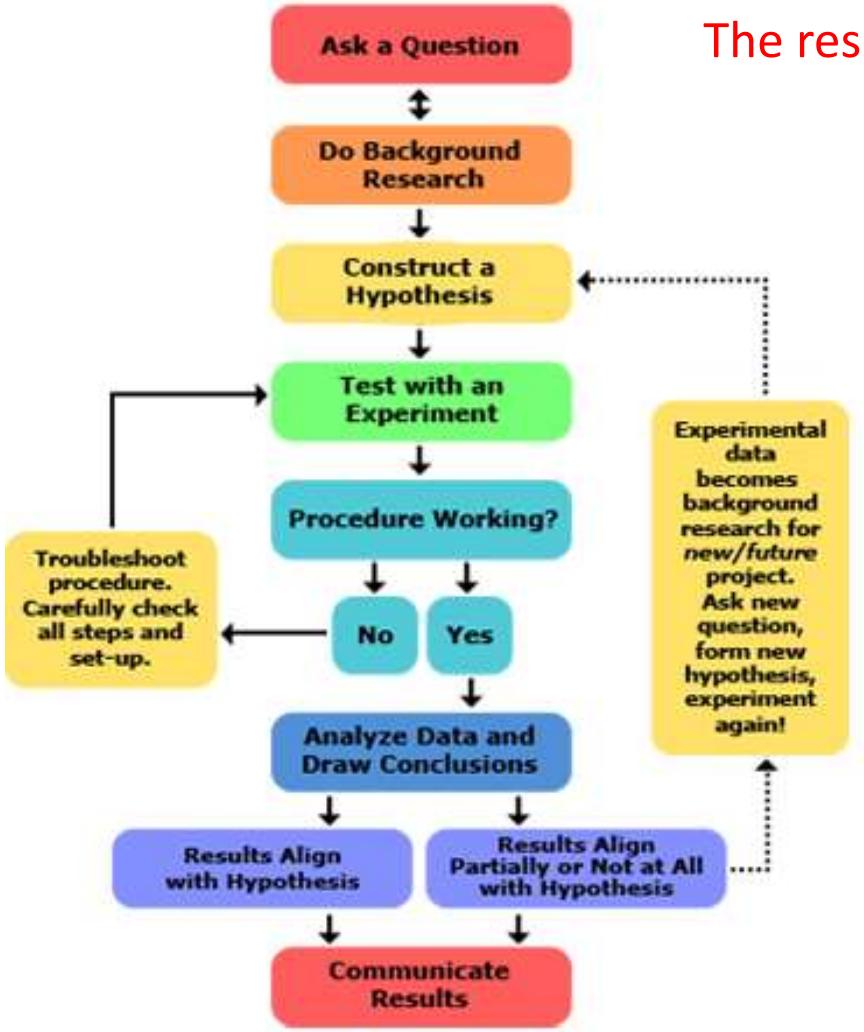
Did the results align, partially align, or not at all with the hypothesis?

Words in hypothesis 1

Words in hypothesis 2



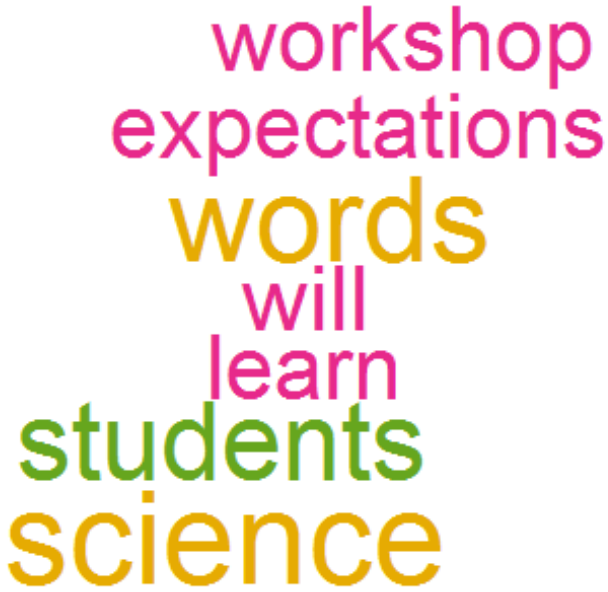
Students' hypothesis 1 vs hypothesis 2 **will** share commo words.



The results align, and there was an additional finding: students have more common words in common in hypothesis 2

Words in hypothesis 1

Words in hypothesis 2



Students’ hypothesis 1 **will** have higher number of letters than hypothesis 2.

Students' hypothesis 1 **<u>will</u>** have higher number of letters than hypothesis 2.

- Is this format correct for data analysis?

hyp1	hyp2
685	155
216	183
137	92
226	147
101	124
127	124
76	140
117	143
	78
	120

Students' hypothesis 1 **will** have higher number of letters than hypothesis 2.

- Is this format correct for data analysis?

No

hyp1	hyp2
685	155
216	183
137	92
226	147
101	124
127	124
76	140
117	143
	78
	120

Students' hypothesis 1 **<u>will</u>** have higher number of letters than hypothesis 2.

- What is the dependent variable?
- What is the independent variable?

hyp1	hyp2
685	155
216	183
137	92
226	147
101	124
127	124
76	140
117	143
	78
	120

Students' hypothesis 1 **<u>will</u>** have higher number of letters than hypothesis 2.

hyp1	hyp2
685	155
216	183
137	92
226	147
101	124
127	124
76	140
117	143
	78
	120

- What is the dependent variable?
  - Number of letters
- What is the independent variable?
  - Hypotheses

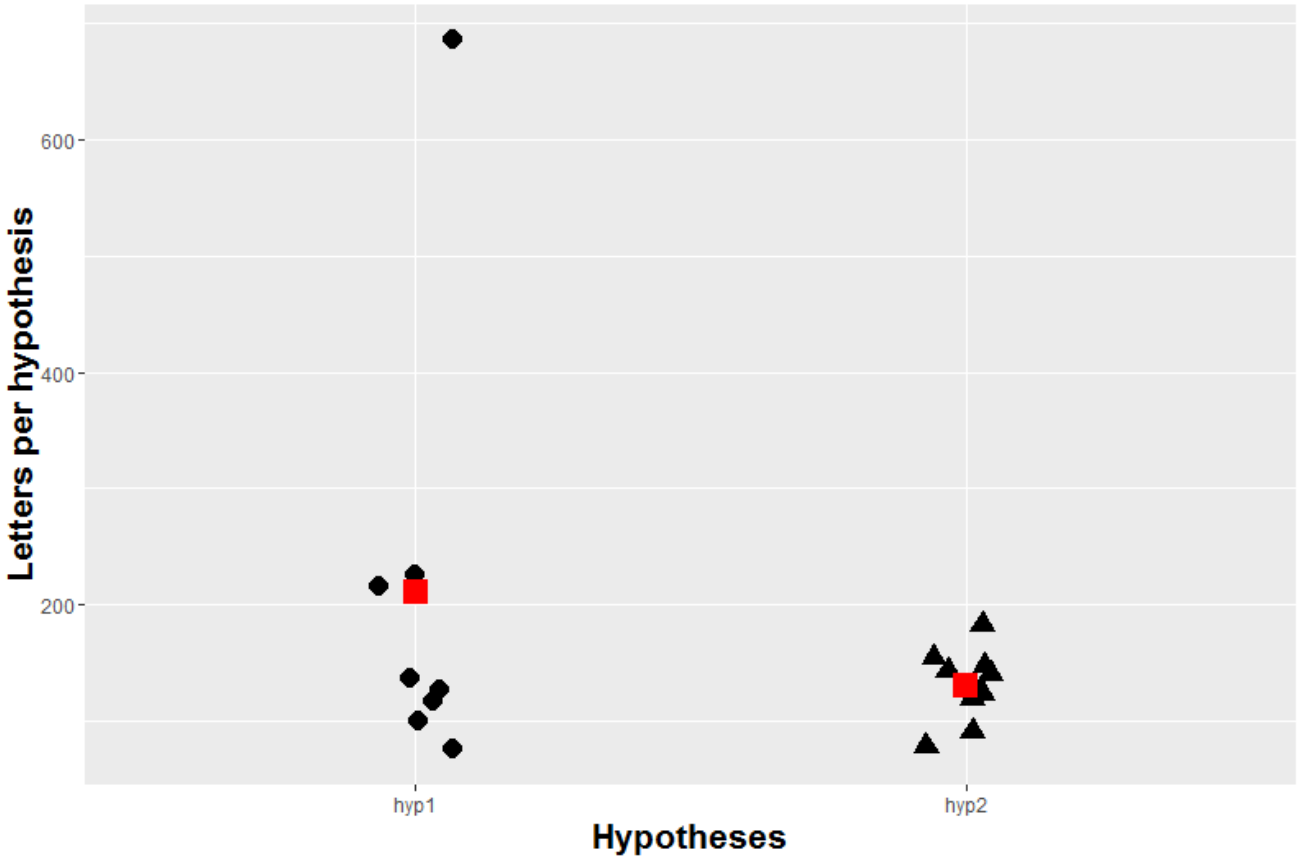
Students' hypothesis 1 **<u>will</u>** have higher number of letters than hypothesis 2.

- Variables = titles of columns
- Rows = observations for each variable

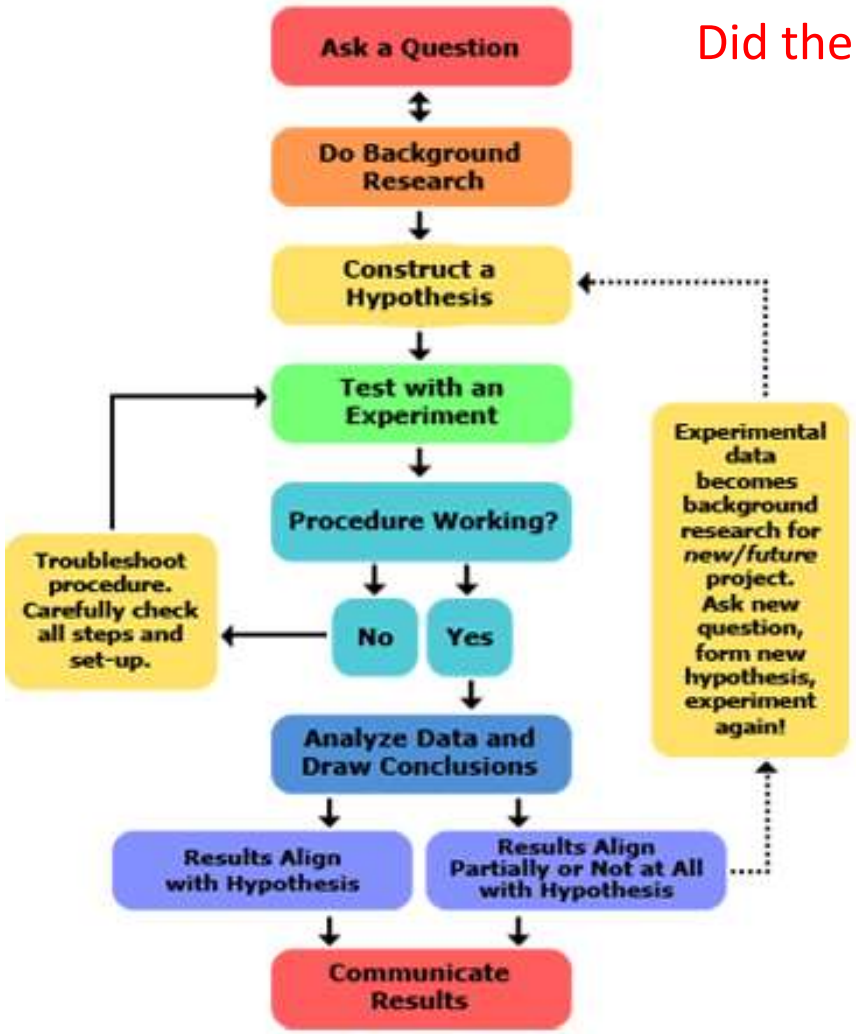
hypothesis	letters
hyp1	685
hyp1	216
hyp1	137
hyp1	226
hyp1	101
hyp1	127
hyp1	76
hyp1	117
hyp2	155
hyp2	183
hyp2	92
hyp2	147
hyp2	124
hyp2	124
hyp2	140
hyp2	143
hyp2	78
hyp2	120

Students' hypothesis 1 **<u>will</u>** have higher number of letters than hypothesis 2.

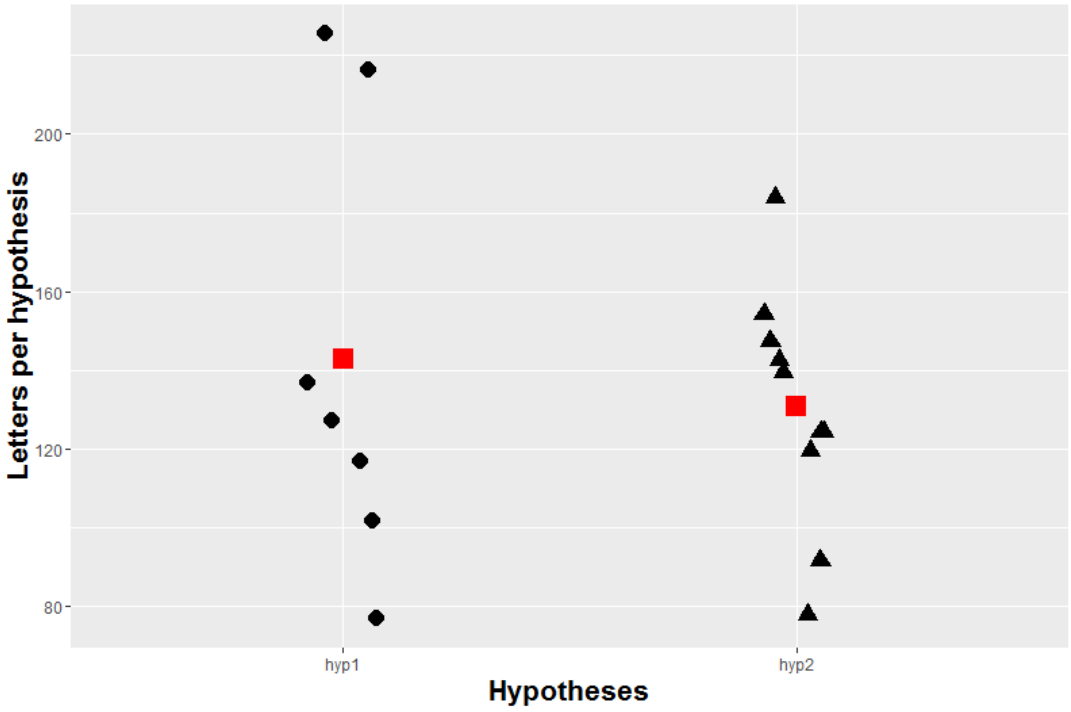
- There is an outlier that may prevent us from correctly interpreting the results



Students' hypothesis 1 **will** have higher number of letters than hypothesis 2.



Did the results align, partially align, or not at all with the hypothesis?



How many variable are present in this table?

name	Quiz1	Quiz2	Quiz3	Quiz4	Quiz5	Quiz6	Topic	Outline	First Draft	Final Draft	Reading Assignments	Attendance	Bonus	Exam1	Exam2	Exam3	Grade
E[redacted]	0	4	6	1.8			5	5	10		30	30	19	78.3	64.4		79.20%
K[redacted]	9	5	7	6			5	5	10		30	30	21	73	91.8		91.50%
D[redacted]	7	11	10	8.8			5	5	10		29	29.5	12.5	85.8	108.4		100.60%
J[redacted]	3	5	6	6			5	5	10		30	30	16.5	85.8	86.8		90.30%
L[redacted]	9.5	0	5	2			0	5	0		28	29	19	100.6	79.6		86.80%
B[redacted]	10	7	8	5.2			5	5	10		30	30	21.5	75.7	83		90.80%
U[redacted]	2	3	7	6			5	5	10		29.5	30	15	85.8	69.4		83.70%
J[redacted]	12	8	9	7.5			5	5	10		30	30	13	82.1	75.5		89.70%
K[redacted]	10	5	9	8.3			5	5	0		30	30	25.5	82.1	81.3		91%
Y[redacted]	0	6	3	10.7			5	5	10		29.5	29.5	13.5	78.3	70.5		81.60%
M[redacted]	8	5	5	7.8			5	5	10		29.5	29.5	18.5	96	89.5		96.50%
C[redacted]	10	12	12	12			5	5	10		30	30	19.5	93.2	94.3		104.10%
B[redacted]	0	7	0	4.7			5	5	10		29.5	29.5	11	82.1	80.4		82.60%
J[redacted]	5	8	7	2.8			5	5	10		29.5	29	14.5	71	70.6		80.40%
D[redacted]	8	5	6	3			5	5	10		30	29.5	19.5	78.4	79.5		87.20%
C[redacted]	5.5	3	3	7.2			5	0	10		30	29.5	18.5	67.3	54.6		73%
J[redacted]	5.5	7	9	10.7			5	5	10		30	30	17	96.9	103.8		103.10%
N[redacted]	11.5	12	8	1.7			5	0	10		29	29.5	17	75.7	83.6		88.40%
D[redacted]	8	5	7	1.7			5	5	10		30	30	23.5	82.1	74.4		88%
D[redacted]	9.5	5	0	EX			5	5	10		30	29.5	18	78.4	77.6		86.50%
R[redacted]	EX	4	5	EX			5	5	10		29	29.5	10	75.6	47.7		73.60%
D[redacted]	11.5	6	8	9.6			5	5	10		30	30	18	85.8	72.2		91%
D[redacted]	5	6	8	8.7			5	5	10		30	29.5	11.5	78.4	91		90%
E[redacted]	9	6	12	9.2			5	5	10		30	30	12.5	111.7	87.2		102.40%
D[redacted]	8	9	0	9			5	5	10		30	29.5	20	89.5	86.8		94.30%

How many variable are present in this table?

1	2						3	4	5		6	7	8	9			10
name	Quiz1	Quiz2	Quiz3	Quiz4	Quiz5	Quiz6	Topic	Outline	First Draft	Final Draft	Reading Assignments	Attendance	Bonus	Exam1	Exam2	Exam3	Grade
E[redacted]	0	4	6	1.8			5	5	10		30	30	19	78.3	64.4		79.20%
K[redacted]	9	5	7	6			5	5	10		30	30	21	73	91.8		91.50%
D[redacted]	7	11	10	8.8			5	5	10		29	29.5	12.5	85.8	108.4		100.60%
J[redacted]	3	5	6	6			5	5	10		30	30	16.5	85.8	86.8		90.30%
L[redacted]	9.5	0	5	2			0	5	0		28	29	19	100.6	79.6		86.80%
B[redacted]	10	7	8	5.2			5	5	10		30	30	21.5	75.7	83		90.80%
U[redacted]	2	3	7	6			5	5	10		29.5	30	15	85.8	69.4		83.70%
J[redacted]	12	8	9	7.5			5	5	10		30	30	13	82.1	75.5		89.70%
K[redacted]	10	5	9	8.3			5	5	0		30	30	25.5	82.1	81.3		91%
Y[redacted]	0	6	3	10.7			5	5	10		29.5	29.5	13.5	78.3	70.5		81.60%
M[redacted]	8	5	5	7.8			5	5	10		29.5	29.5	18.5	96	89.5		96.50%
C[redacted]	10	12	12	12			5	5	10		30	30	19.5	93.2	94.3		104.10%
B[redacted]	0	7	0	4.7			5	5	10		29.5	29.5	11	82.1	80.4		82.60%
J[redacted]	5	8	7	2.8			5	5	10		29.5	29	14.5	71	70.6		80.40%
D[redacted]	8	5	6	3			5	5	10		30	29.5	19.5	78.4	79.5		87.20%
C[redacted]	5.5	3	3	7.2			5	0	10		30	29.5	18.5	67.3	54.6		73%
J[redacted]	5.5	7	9	10.7			5	5	10		30	30	17	96.9	103.8		103.10%
N[redacted]	11.5	12	8	1.7			5	0	10		29	29.5	17	75.7	83.6		88.40%
D[redacted]	8	5	7	1.7			5	5	10		30	30	23.5	82.1	74.4		88%
D[redacted]	9.5	5	0	EX			5	5	10		30	29.5	18	78.4	77.6		86.50%
R[redacted]	EX	4	5	EX			5	5	10		29	29.5	10	75.6	47.7		73.60%
D[redacted]	11.5	6	8	9.6			5	5	10		30	30	18	85.8	72.2		91%
D[redacted]	5	6	8	8.7			5	5	10		30	29.5	11.5	78.4	91		90%
E[redacted]	9	6	12	9.2			5	5	10		30	30	12.5	111.7	87.2		102.40%
D[redacted]	8	9	0	9			5	5	10		30	29.5	20	89.5	86.8		94.30%