

STEM Forum Minneapolis, May 2015

4

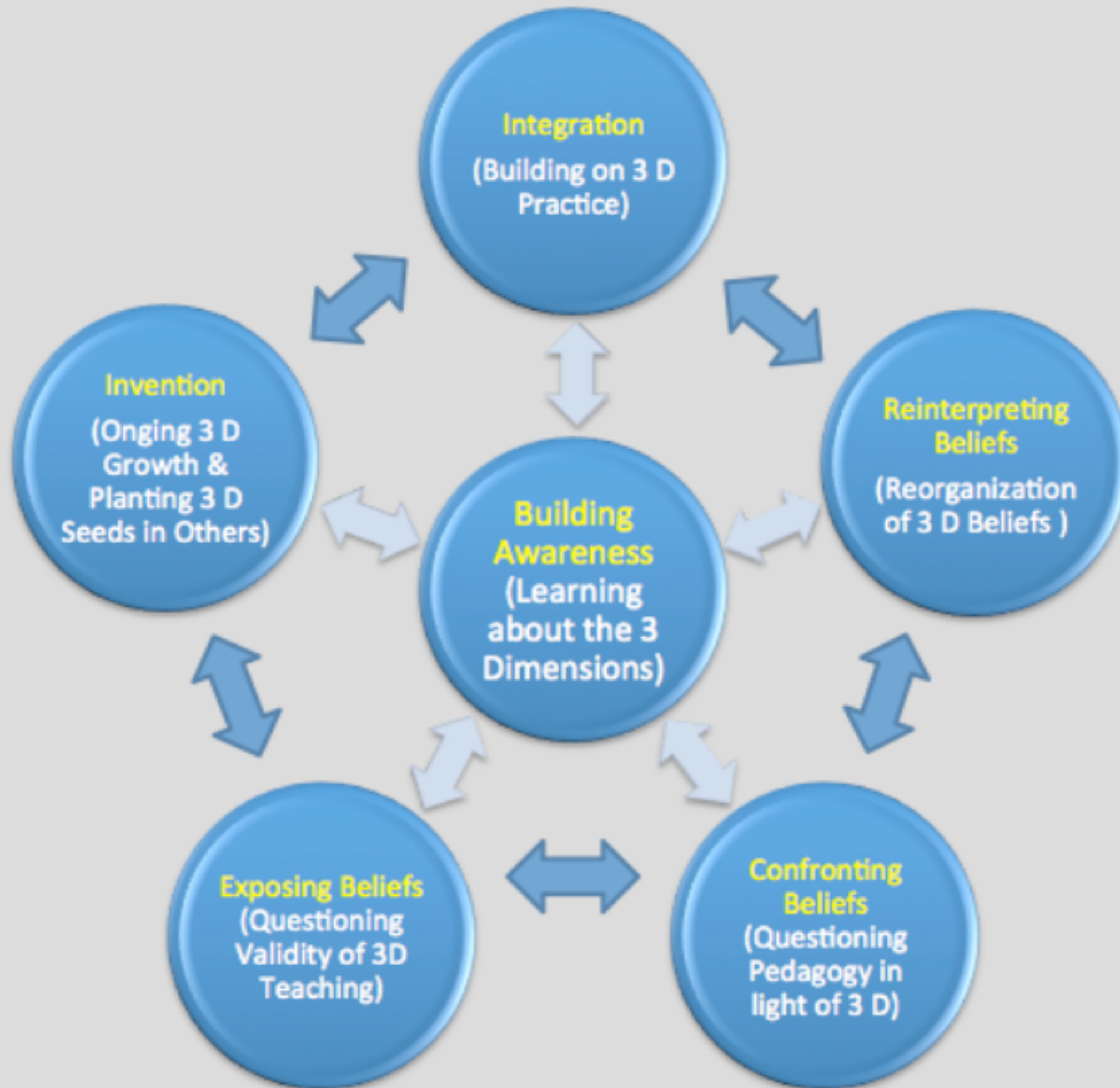
Analyzing and Interpreting Data

Who ARE
you?

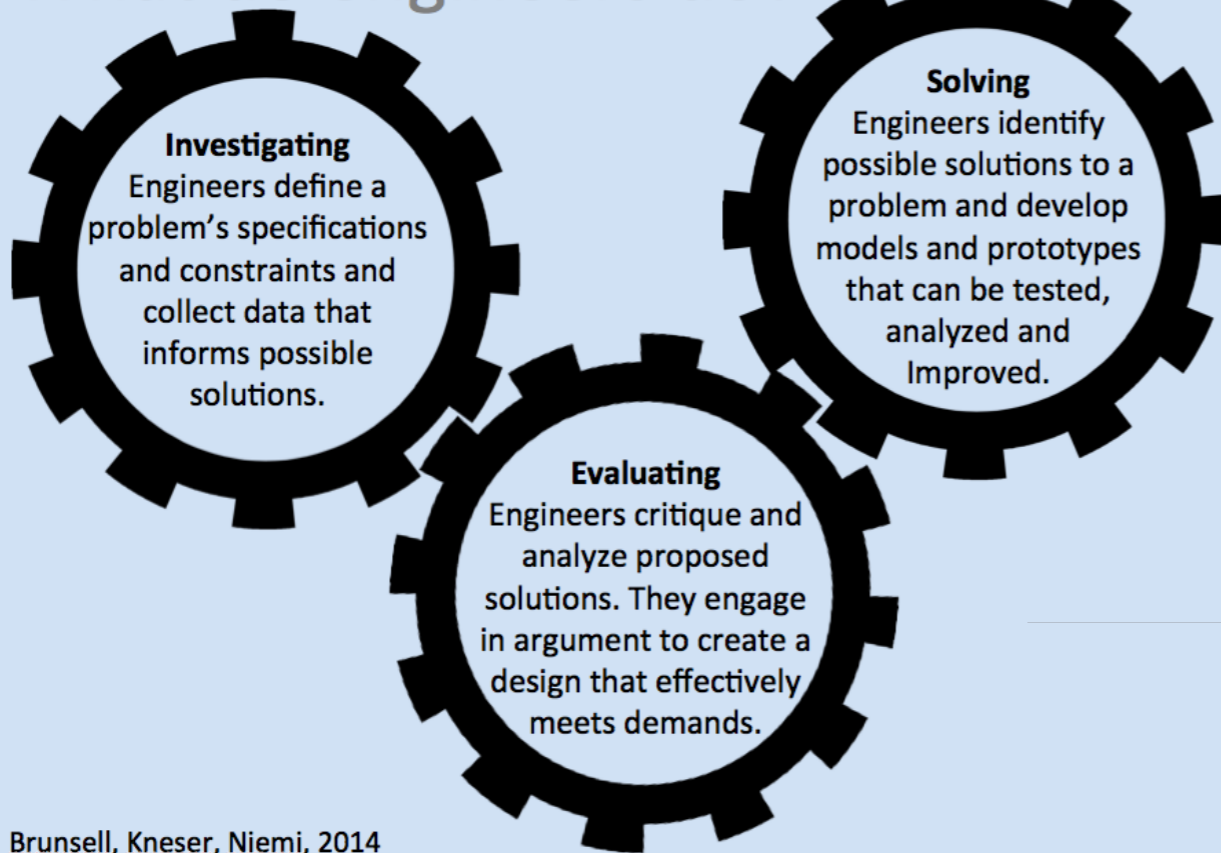
Conceptual Change...

Assessment





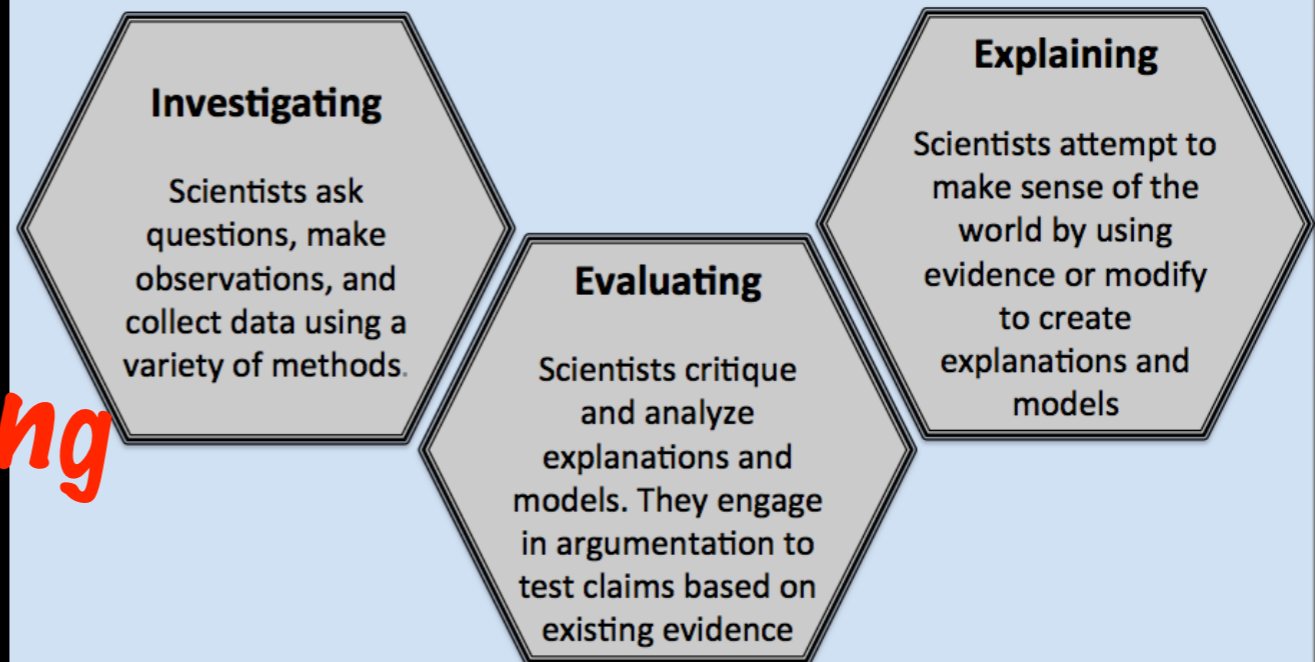
What do engineers do?



Brunsell, Kneser, Niemi, 2014

Analyzing & Interpreting Data

What do scientists do?



Brunsell, Kneser, Niemi, 2014

Analyzing & Interpreting Data

Practice 4

Analyzing and Interpreting Data

Once collected, data must be presented in a form that can reveal any patterns and relationships and that allows results to be communicated to others. Because raw data as such have little meaning, a major practice of scientists is to organize and interpret data through tabulating, graphing, or statistical analysis. Such analysis can bring out the meaning of data—and their relevance—so that they may be used as evidence.

skills

verbs

tools

products

large.data.sets

represent.data.tables
use.and.share.pictures

use.observations
different.data.sets

analyze.data

consider.limits.of.data.analysis

compare.contrast.data

compare.predictions
apply.statistics

record.data

use.graphs

High School

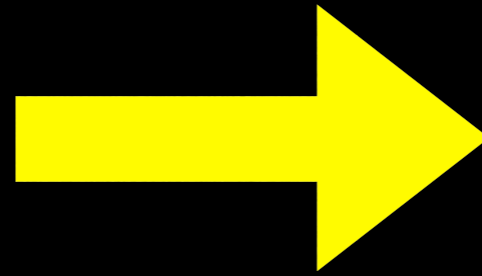
Complex analysis

Scatterplots

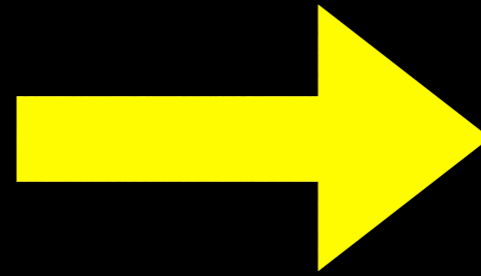
Statistical analysis

Computer simulations

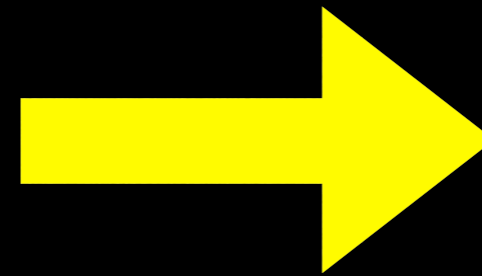
Large Data Sets



0 Heads



1 Head



2 Heads

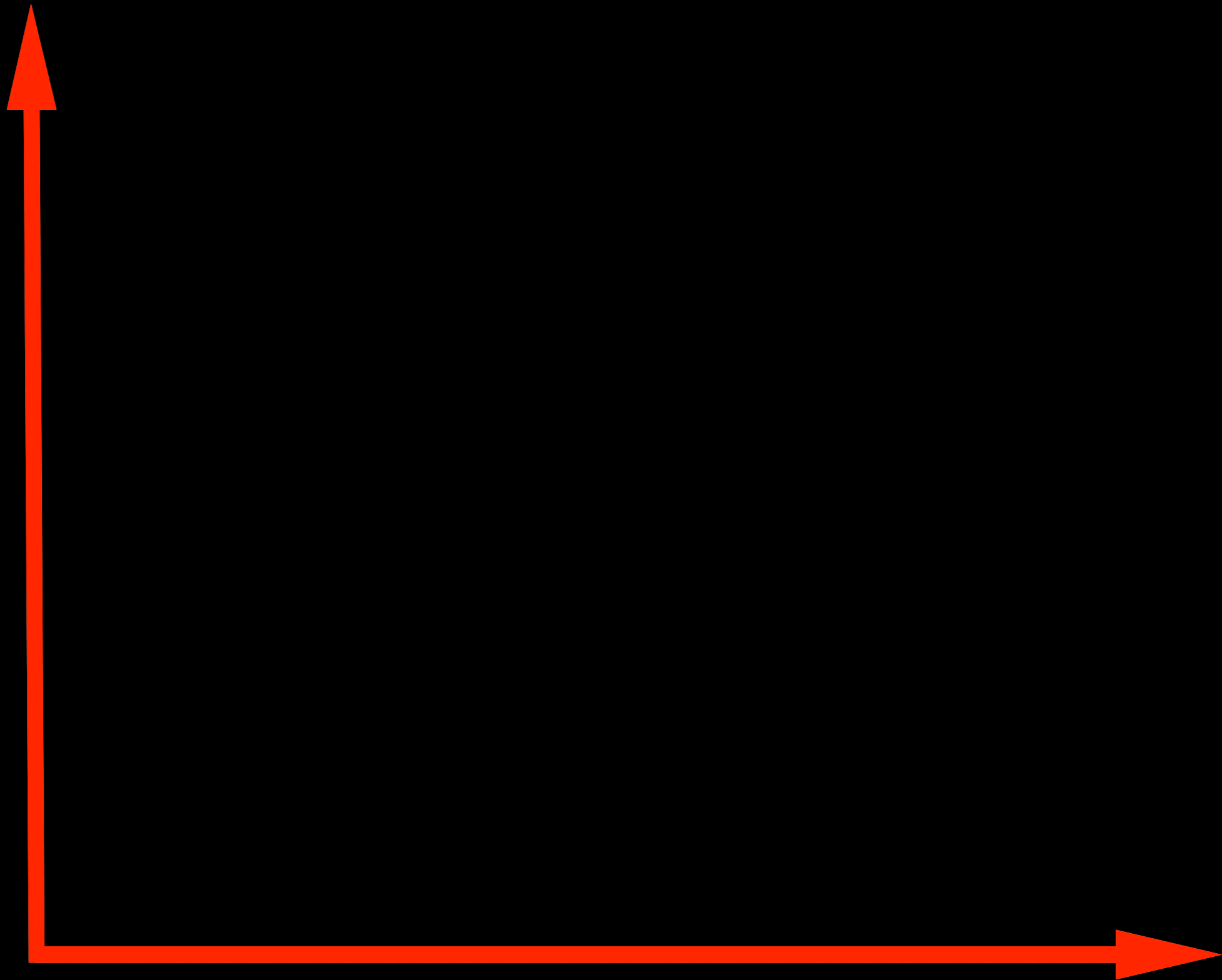
Count

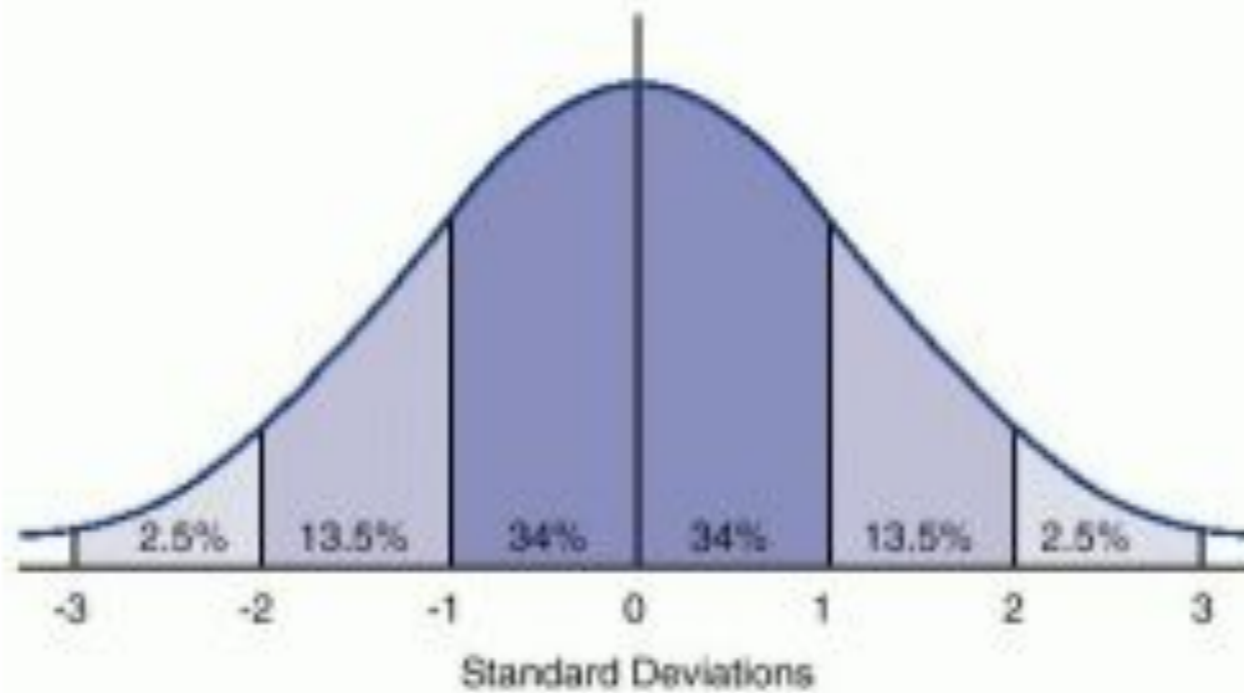
0

1

2

Heads





Normal distribution. The approximate percentage of the area (or frequency) lying under the curve between standard deviations is indicated.



Natural Light (cm)

Artificial Light (cm)

	A	B
2	46	45
3	46	45
4	46	46
5	47	47
6	47	48
7	47	49
8	48	51
9	49	52
10	49	54
11	50	51
12	50	55
13	50	54
14	51	58
15	51	57
16	52	58
17	52	48
18	52	57
19	52	61
20	53	61
21	53	60
22	54	55
23	54	58
24	54	54
25	55	55
26	55	64
27	55	63
28	56	62
29	56	63
30	56	58
31	57	62
32	57	60
33	57	58
34	59	57
35	59	55
36	59	58
37	59	55
38	59	52
39	60	55
40		
41		
42	52.94736842	55.28947368
43		
44		



Plants under natural light

mean=52.9 cm

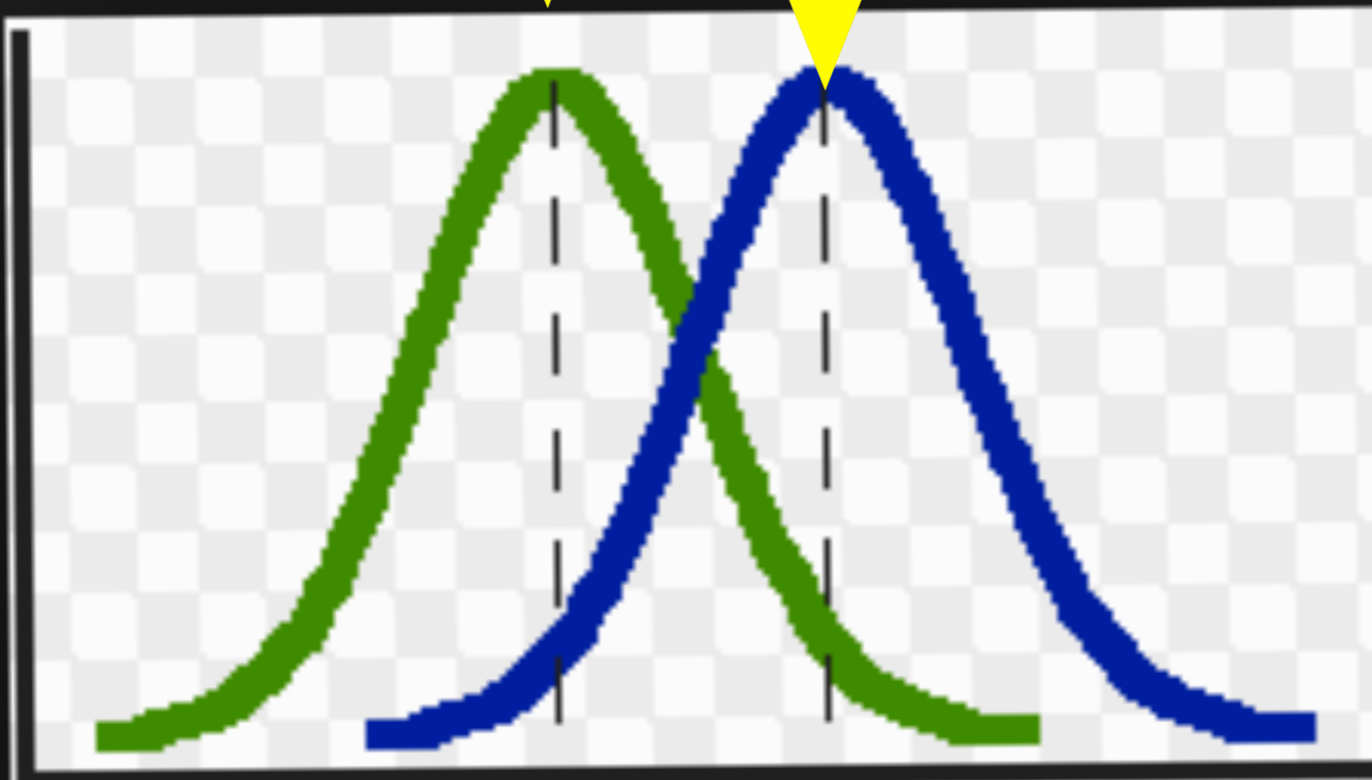


Plants under artificial light

mean=55.3 cm

Plants under natural light

Plants under artificial light



control
group
mean

treatment
group
mean

t-test

Student T-Test Calculator for 2 Independent Means

The Calculator

Enter your sample values into the text boxes below, either one value per line or as a comma delimited list.

Population/Group 1

46
46
46
47
47
47
48
49
49
50
50
50
51
51
52
52
52
52
53
53

Population/Group 2

45
45
46
47
48
49
51
52
54
51
55
54
58
57
58
48
57
61
61
60

Significance Level:

- 0.01
 0.05
 0.10

One-tailed or two-tailed hypothesis?:

- One-tailed
 Two-tailed

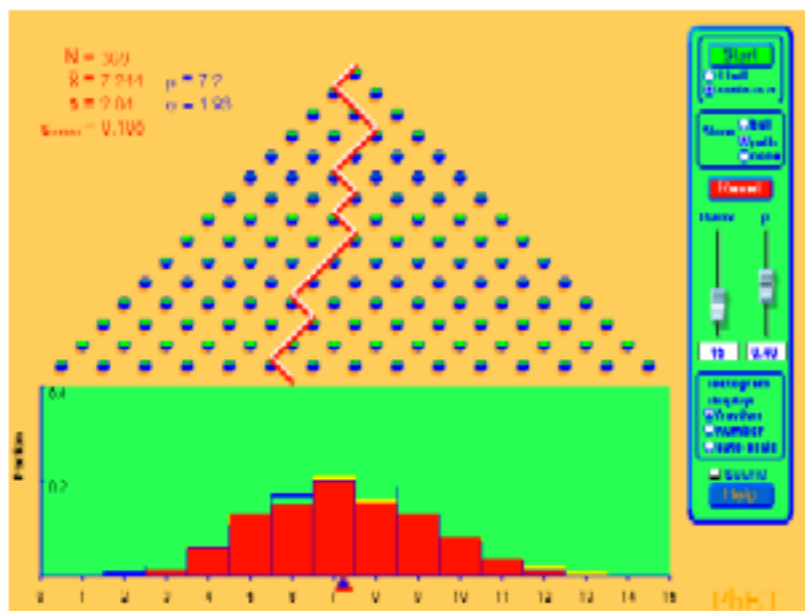
The T-value is 2.133927. The P-Value is 0.036168. The result is significant at $p < 0.05$.

Calculate T and P Values

Reset

95% confidence

Plinko Probability

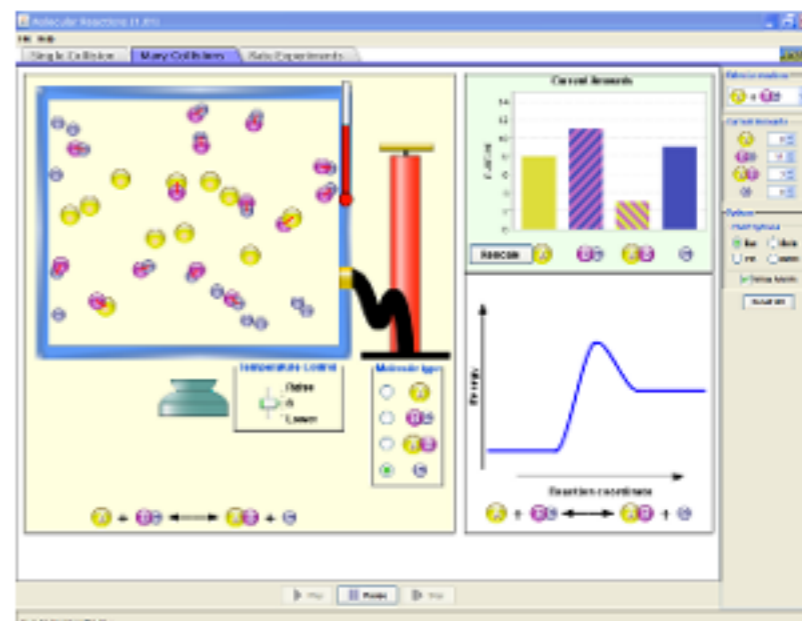


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Version 2.02

Computer simulations
Large Data Sets

Reactions & Rates



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Version 1.07



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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Crosscutting Concepts



Middle School

Display, Analyze, Interpret

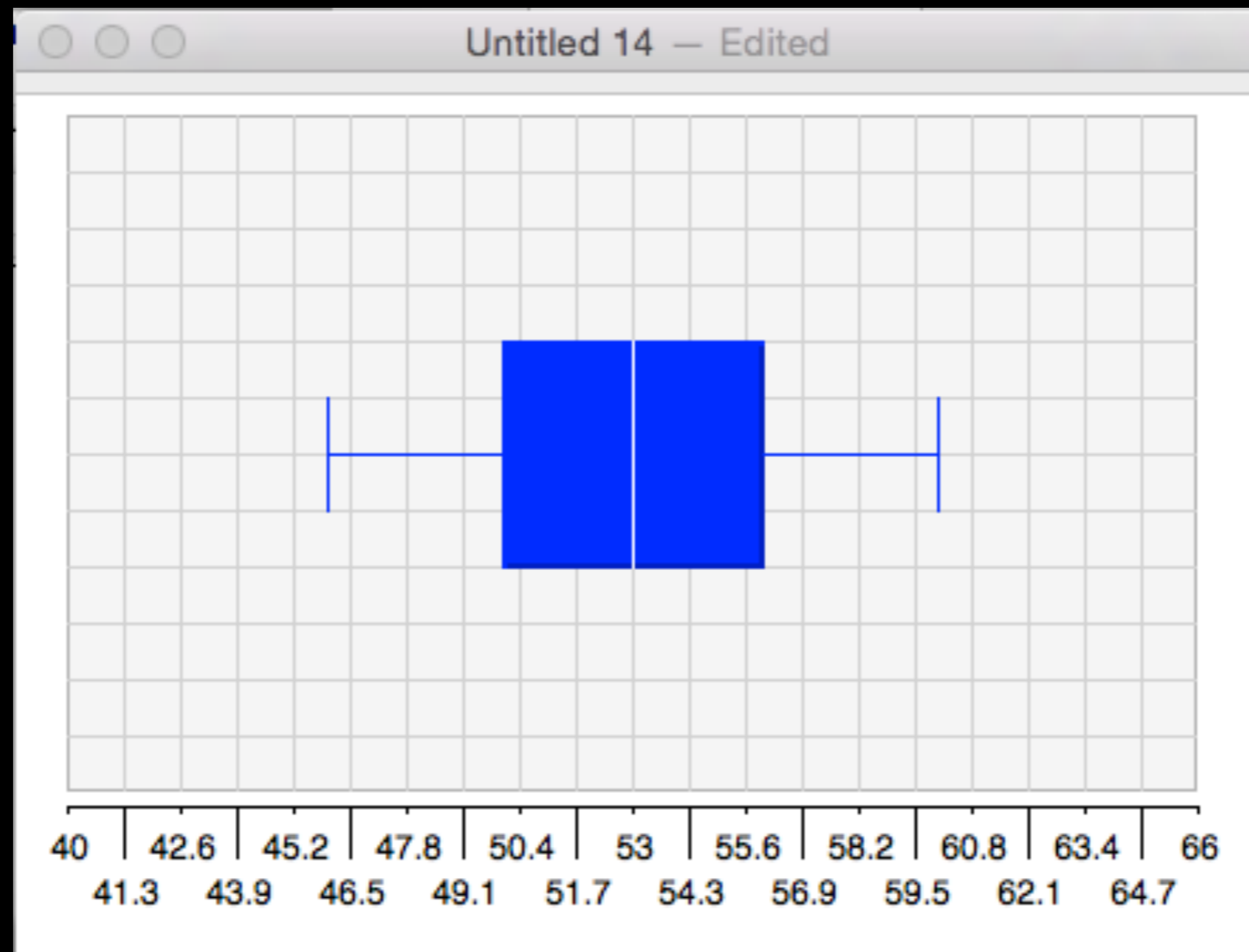
Graphing

Outliers

Averaging

Measurement Error

Box and Whisker Plots



1

2

5

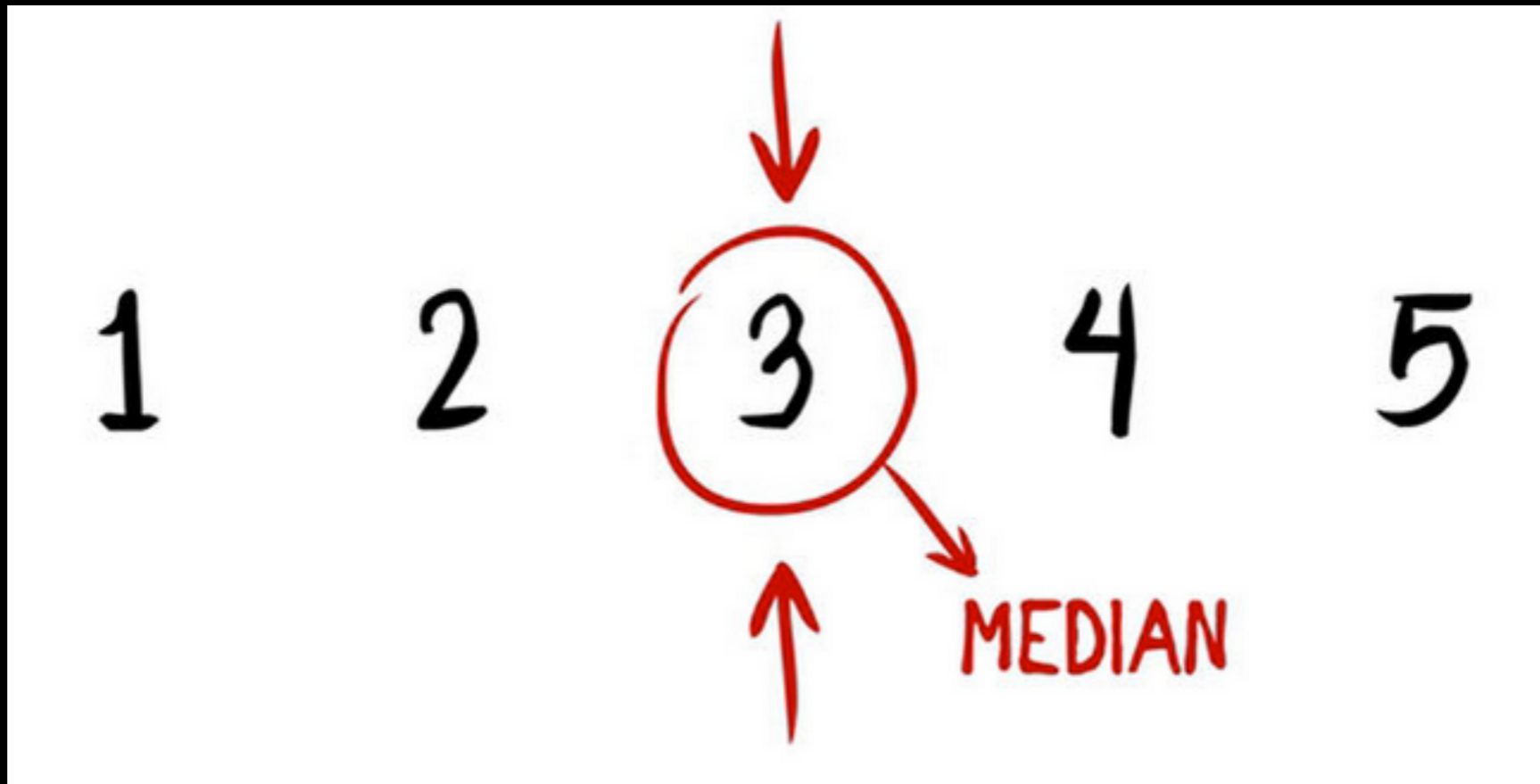
3

4

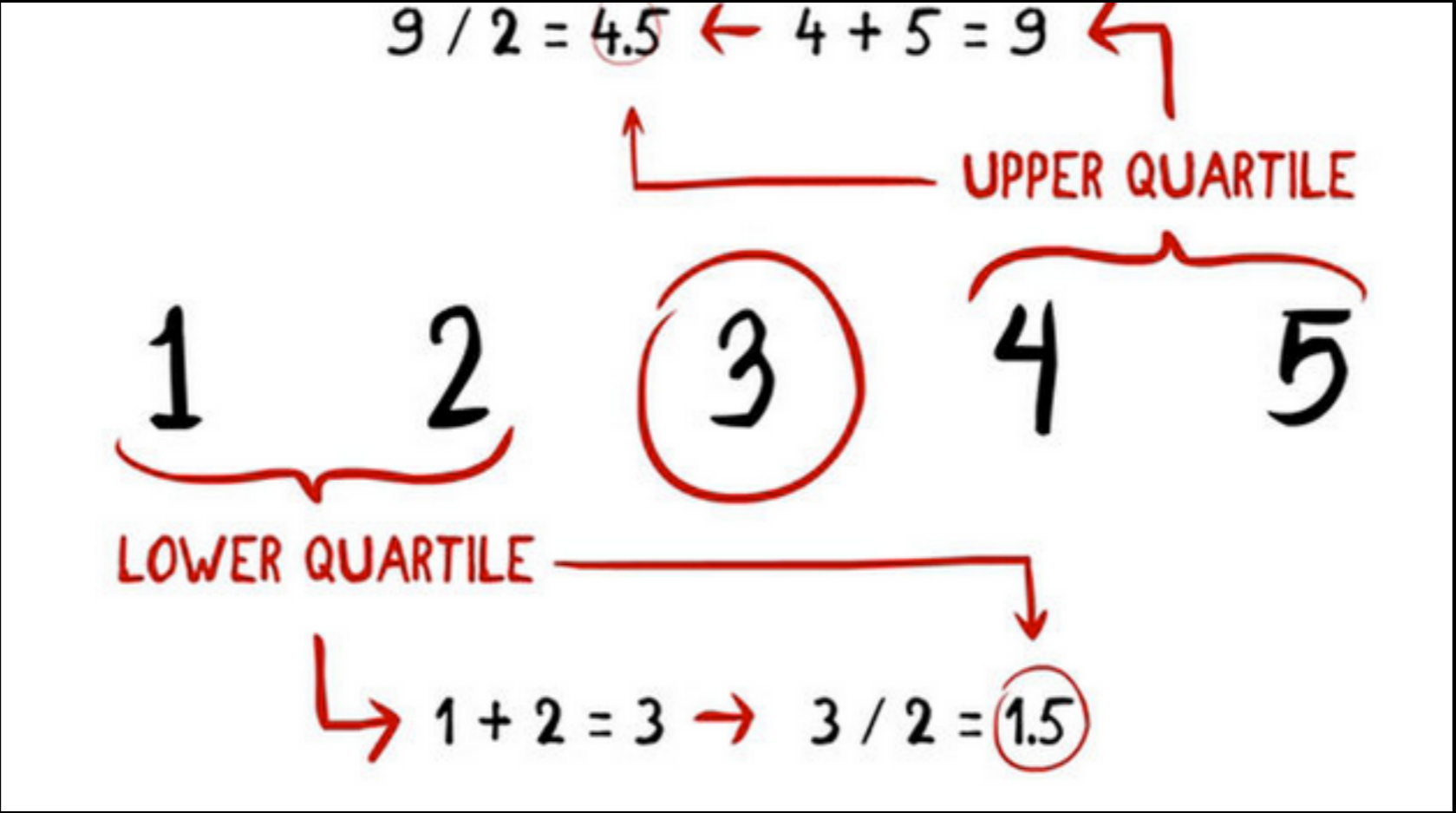
L \longrightarrow **G**

1 2 3 4 5

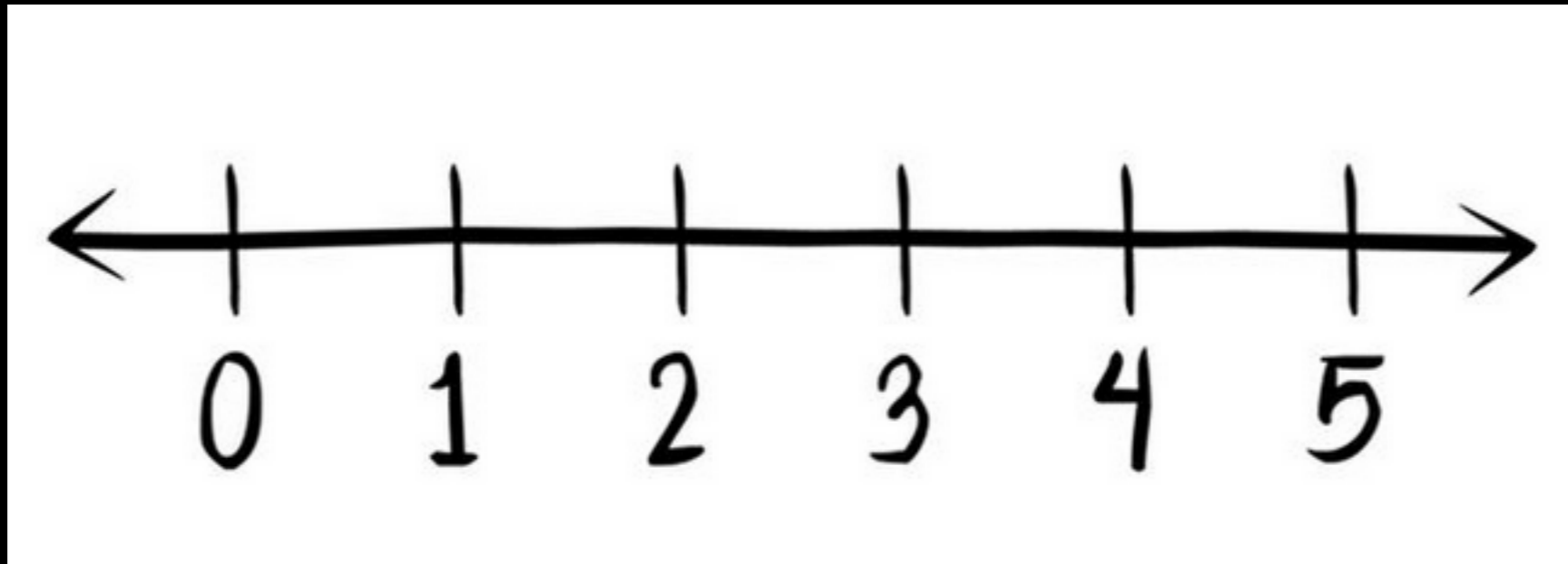
Circle Middle Number



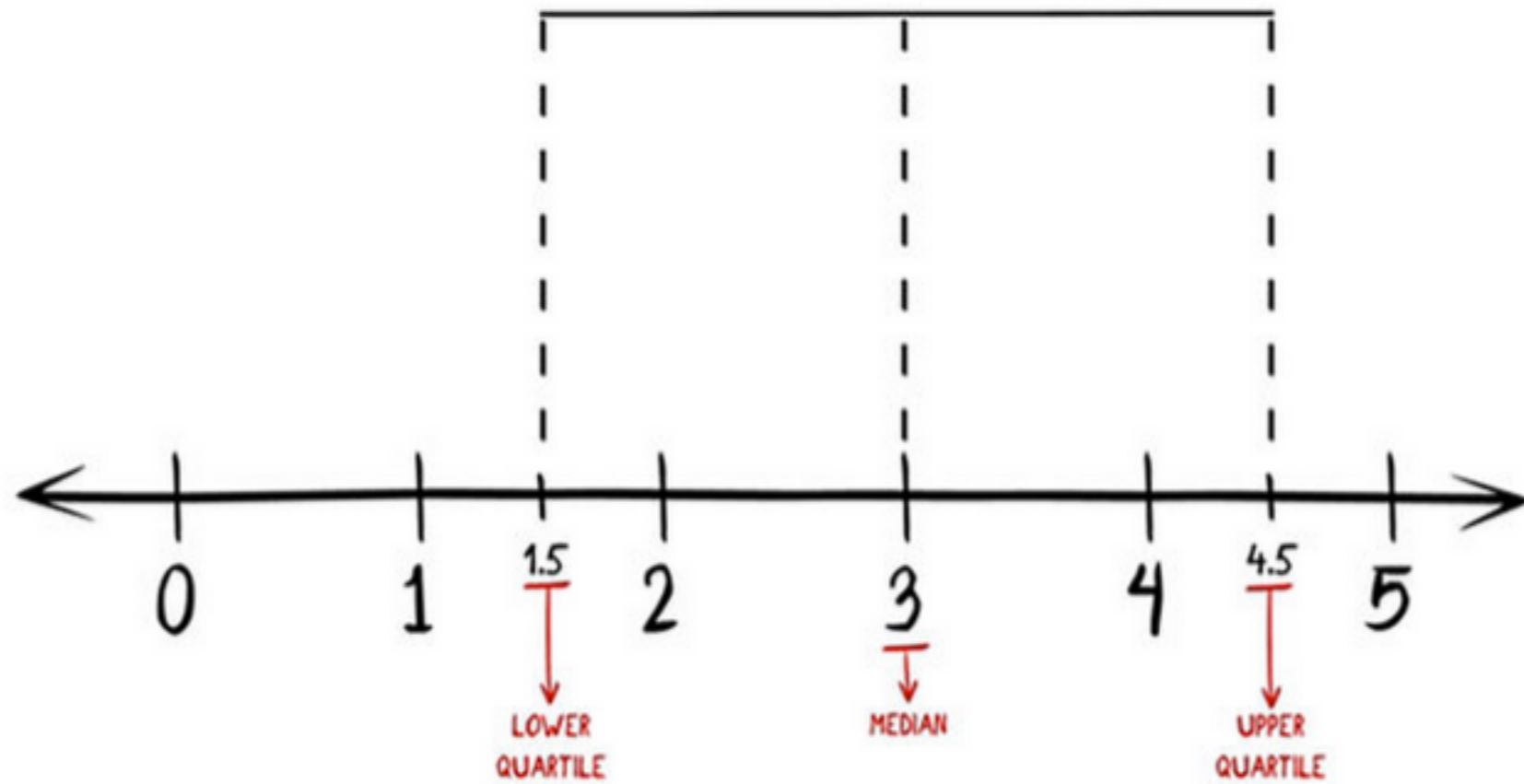
Find 1st/3rd Quartile



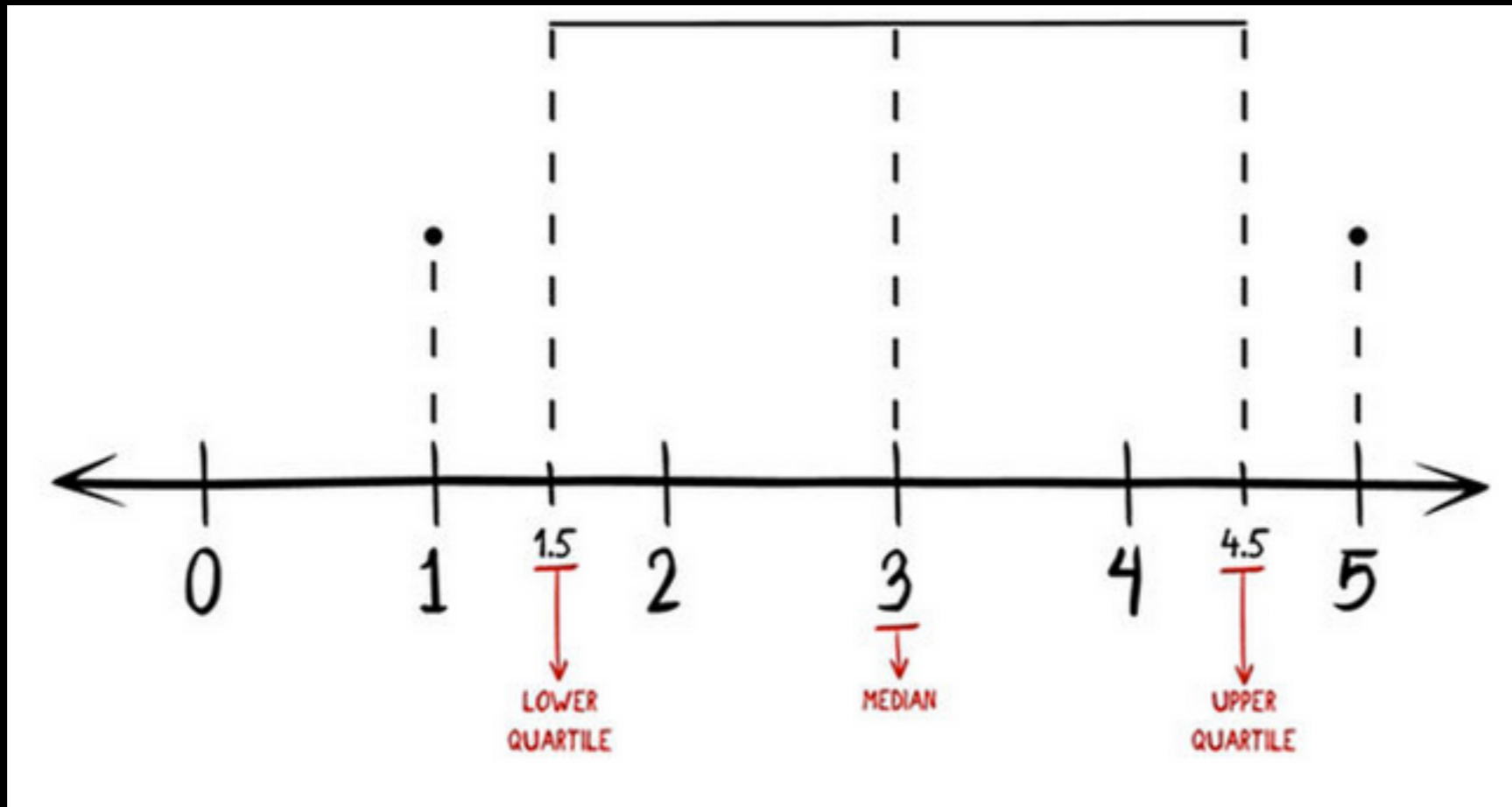
Draw a Plot Line



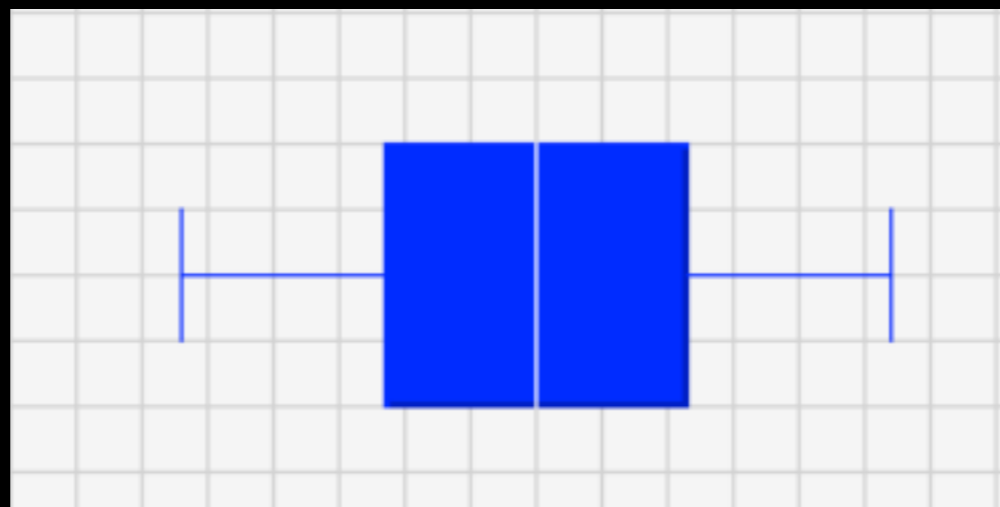
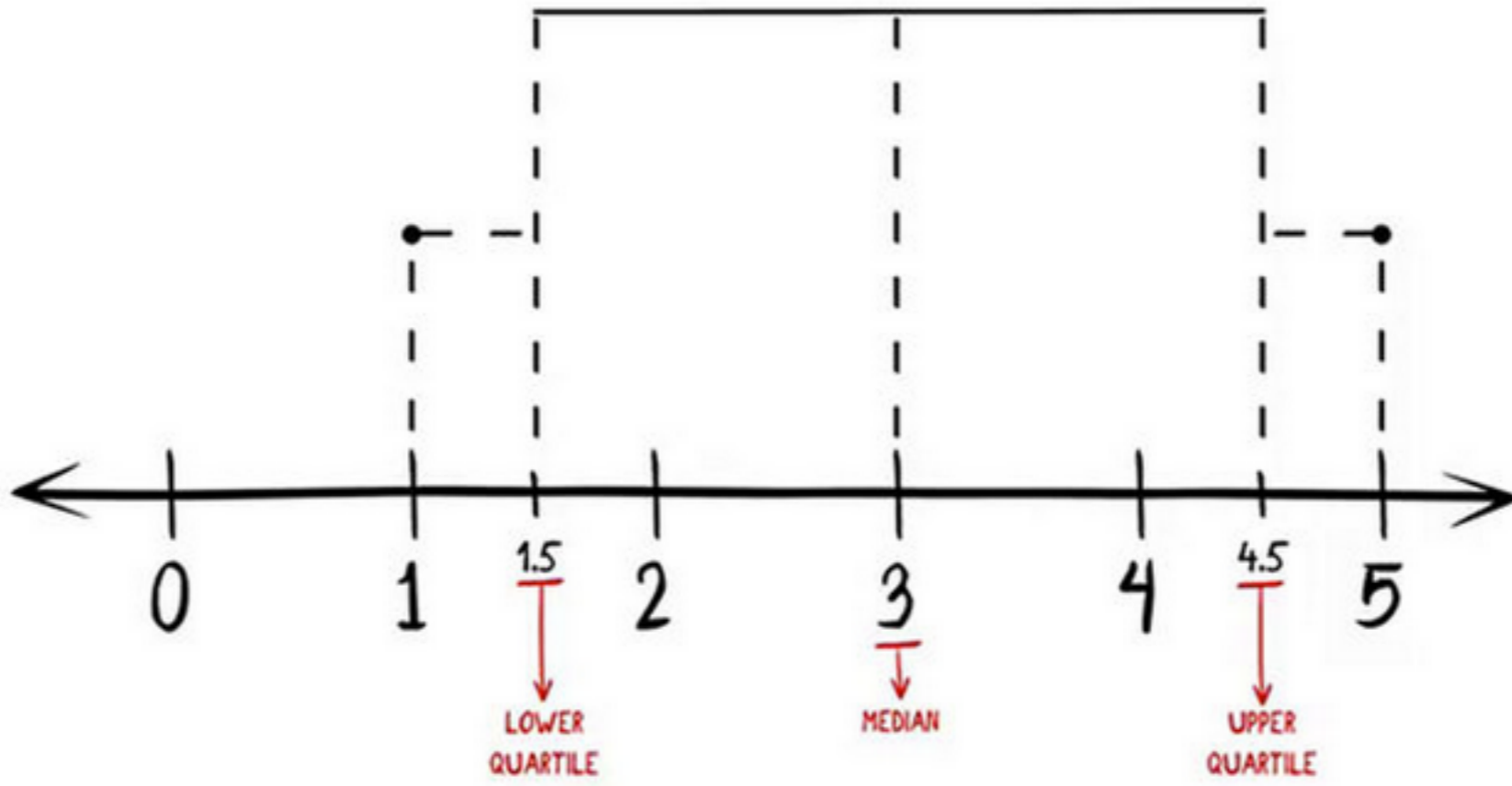
Mark 1st, 2nd, 3rd Quartiles on Line



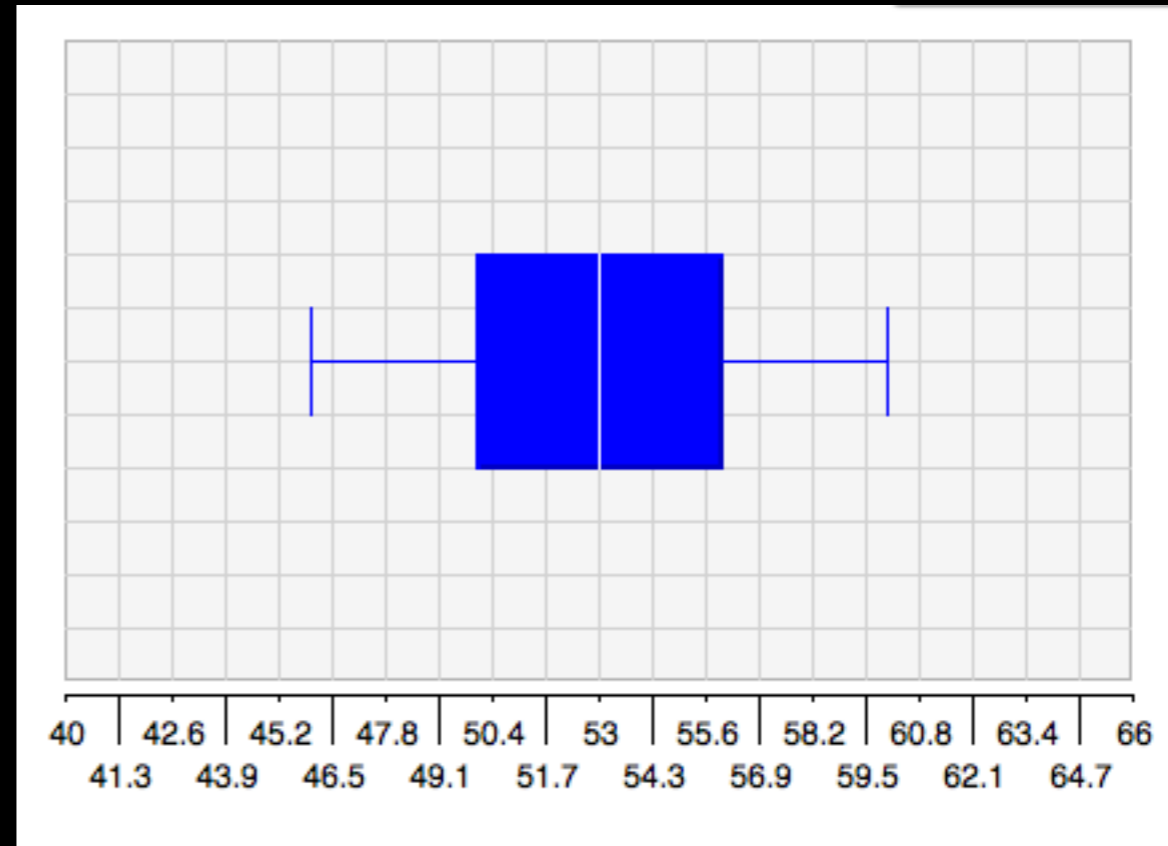
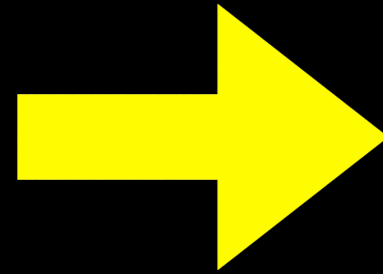
Mark Outliers



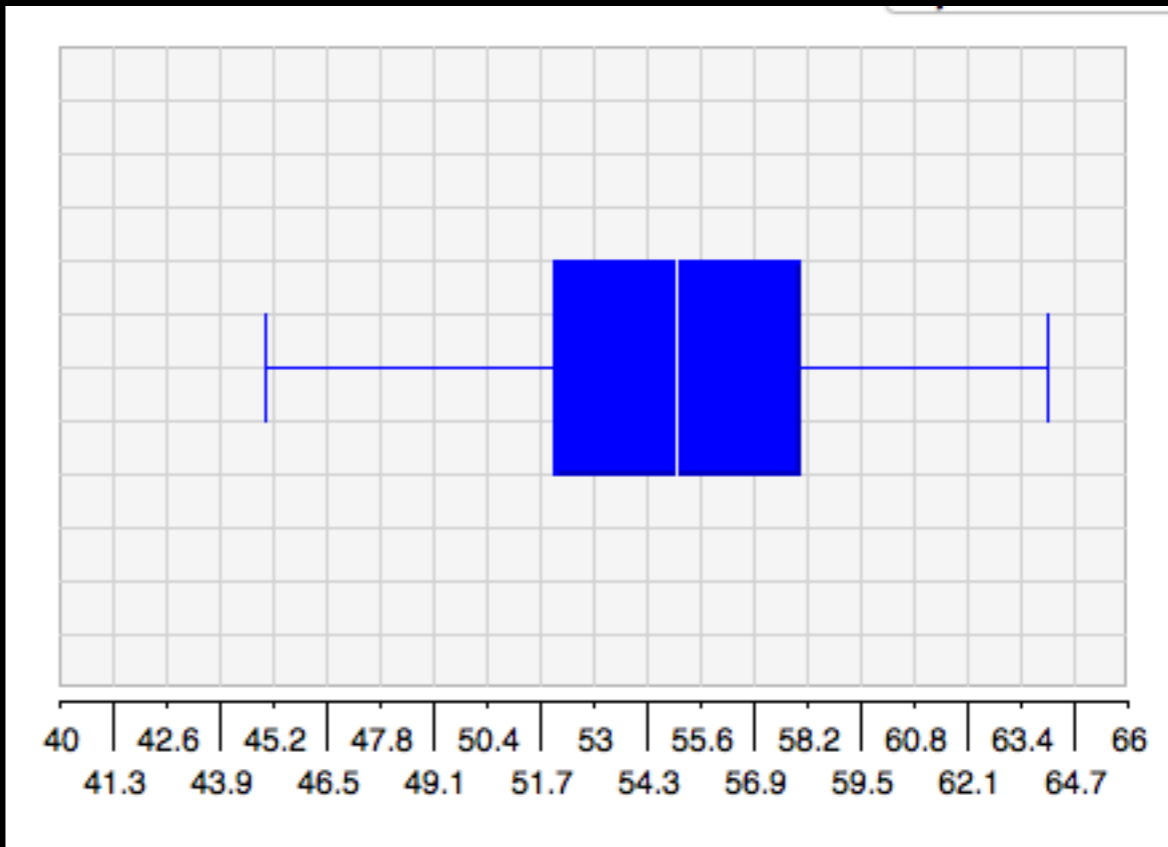
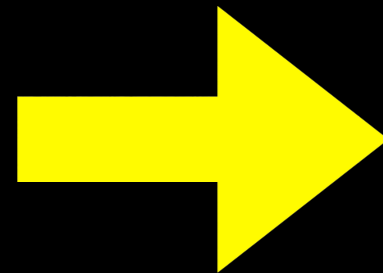
Connect Outliers w/ Horizontal Line



Natural Light



Artificial Light





2127

OLD FAITHFUL ERUPTION DATA

	Time of Day	Duration (sec)	Interval (min)	Time of day	Duration (sec)	Interval (min)
	9/1/99	9:03	253	9/14/99	9:23	236
	9/1/99	10:31	247	9/14/99	10:48	241
	9/1/99	11:57	255	9/14/99	12:07	255
	9/1/99	13:25	276	9/14/99	13:28	237
	9/1/99	14:55	256	9/14/99	14:54	215
	9/1/99	16:29	251	9/14/99	16:13	247
	9/1/99	17:59	260	9/14/99	17:42	237
	9/1/99	19:27	242	9/14/99	19:05	240
	9/3/99	9:02	250	9/15/99	10:41	240
	9/3/99	10:22	244	9/15/99	12:05	245
	9/3/99	11:55	239	9/15/99	13:26	228
	9/3/99	13:22	240	9/15/99	14:46	235
	9/3/99	14:52	253	9/15/99	16:13	261
	9/3/99	16:17	238	9/15/99	17:18	122
	9/3/99	17:51	248	9/16/99	10:28	256
	9/3/99	19:19	264	9/16/99	11:55	242
	9/7/99	9:22	262	9/16/99	13:21	224
	9/7/99	10:50	250	9/16/99	14:43	247
	9/7/99	12:22	249	9/16/99	16:17	257
	9/7/99	13:50	252	9/16/99	17:37	238
	9/7/99	15:15	245	9/16/99	19:00	235
	9/7/99	16:42	252	9/19/99	10:15	255
	9/7/99	17:33	107	9/19/99	11:40	261
	9/7/99	18:59	271	9/19/99	12:40	120
	9/9/99	11:05	274	9/19/99	14:13	261
	9/9/99	12:25	254	9/19/99	17:01	247
	9/9/99	13:52	254	9/19/99	18:08	119
	9/9/99	15:10	239	9/21/99	10:19	150
	9/9/99	16:39	247	9/21/99	11:54	261
	9/9/99	17:58	224	9/21/99	13:21	244
	9/9/99	19:25	249	9/21/99	14:47	235
	9/11/99	14:12	248	9/21/99	16:15	250
	9/11/99	15:32	233	9/21/99	17:36	246
	9/11/99	17:09	260	9/21/99	19:09	265
	9/11/99	18:42	243	9/25/99	10:56	261
	9/12/99	10:57	235	9/25/99	12:34	266
	9/12/99	12:15	267	9/25/99	14:08	270
	9/12/99	14:59	243	9/25/99	15:29	267
	9/12/99	16:30	235	9/25/99	16:54	251
	9/12/99	17:47	207	9/25/99	18:20	247
	9/12/99	19:25	248	8/1/99	11:00	254
	9/13/99	11:00	230	8/1/99	12:24	255
	9/13/99	12:23	257	8/1/99	13:33	131
	9/13/99	13:45	194	8/1/99	15:04	272
	9/13/99	15:13	189	8/1/99	16:29	244
	9/13/99	16:34	236	8/1/99	17:59	260
	9/13/99	17:37	110	8/1/99	19:29	254
	9/13/99	19:11	259	8/6/99	10:01	256
				8/6/99	11:24	260



TEXAS INSTRUMENTS

TI-83 Plus



T PLOT F1

TBLSET F2

FORMAT F3

CALC F4

TABLE

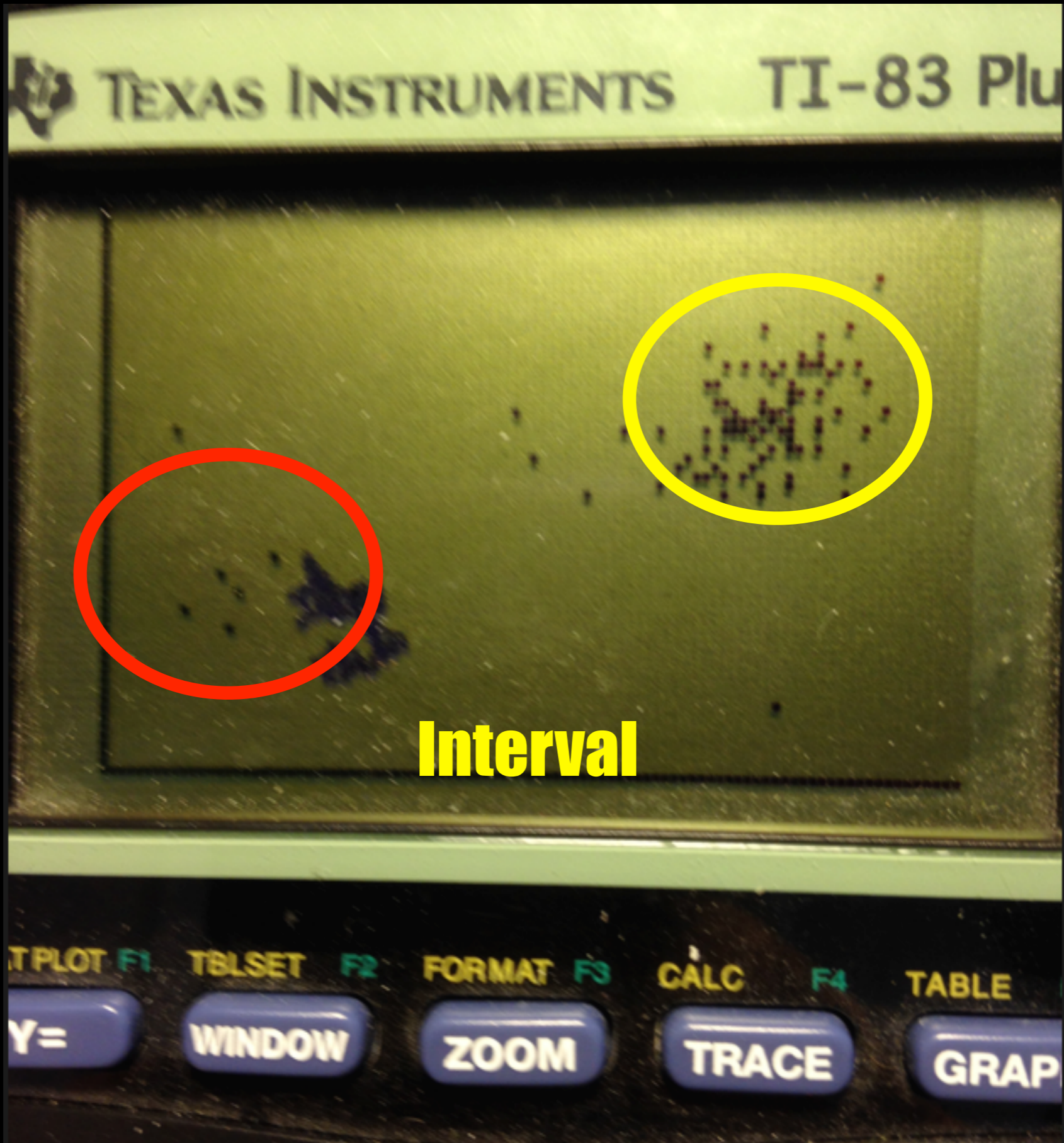
Y=

WINDOW

ZOOM

TRACE

GRAP



Duration

Interval

63

88

Old Faithful Geyser

Recent Activity

Notes

Links

Attachments

Baselines

Last Known
Eruption

1h 0m ago

Latest Eruptions

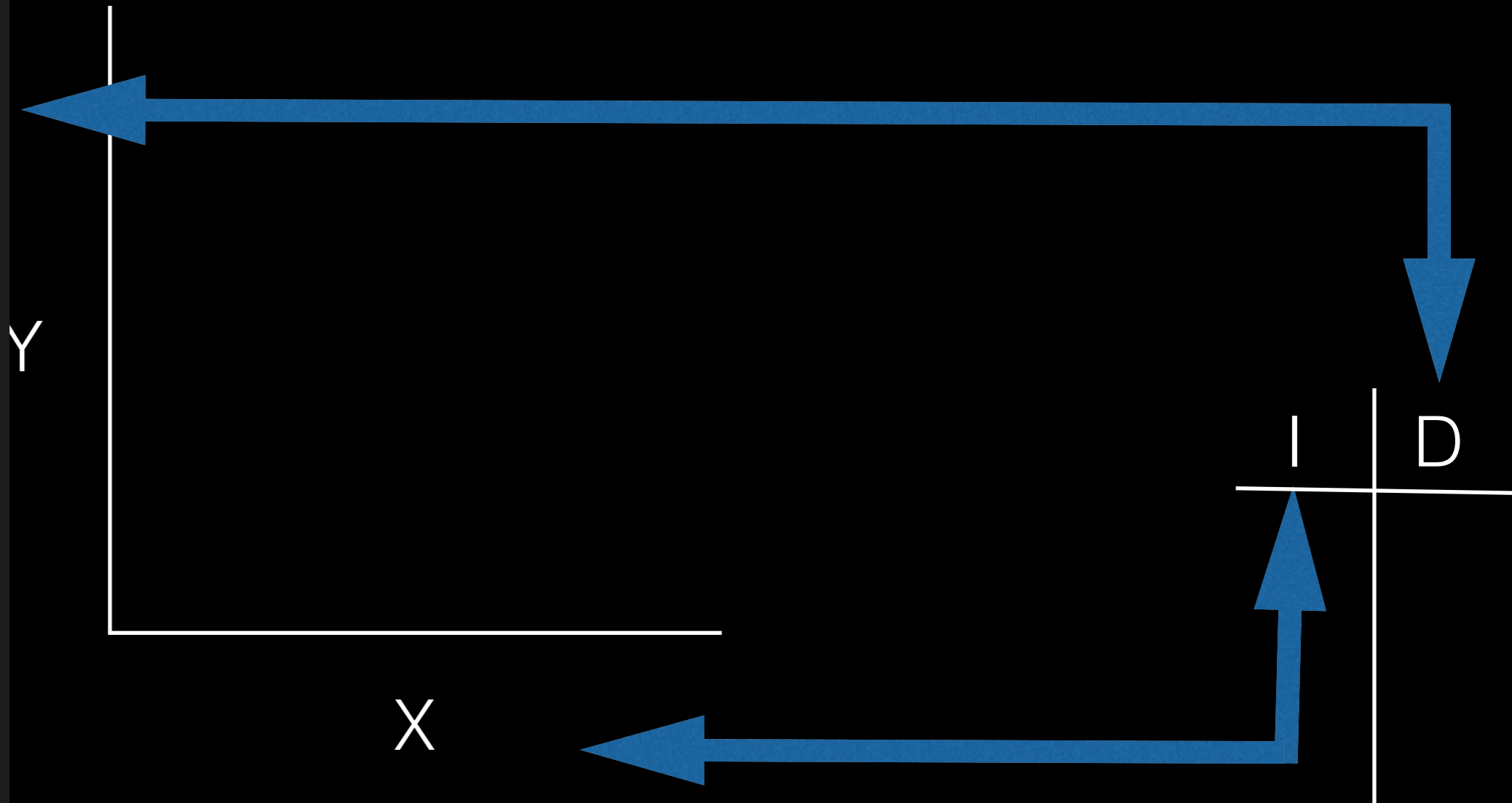
Show 20 entries

Eruption	Duration	Interval
21 Jan 2015 @ 1451 wc		1h 31m
21 Jan 2015 @ 1320 wc		1h 37m
21 Jan 2015 @ 1143 wc		1h 3m
21 Jan 2015 @ 1040 wc		1h 44m
21 Jan 2015 @ 0856 wc long		1h 4m
21 Jan 2015 @ 0752 wc		1h 31m
21 Jan 2015 @ 0621 wc		13h 46m
20 Jan 2015 @ 1635 wc long		1h 25m
20 Jan 2015 @ 1510 wc long		1h 44m
20 Jan 2015 @ 1326 wc long		1h 30m
20 Jan 2015 @ 1156 wc long		1h 37m
20 Jan 2015 @ 1019 wc long		1h 0m
20 Jan 2015 @ 0919 wc short		1h 30m
20 Jan 2015 @ 0749 wc long		1h 26m
20 Jan 2015 @ 0623 ie		12h 35m
19 Jan 2015 @ 1748 wc		1h 33m
19 Jan 2015 @ 1615 wc long		1h 41m
19 Jan 2015 @ 1434 wc long		1h 32m
19 Jan 2015 @ 1302 wc long		1h 49m

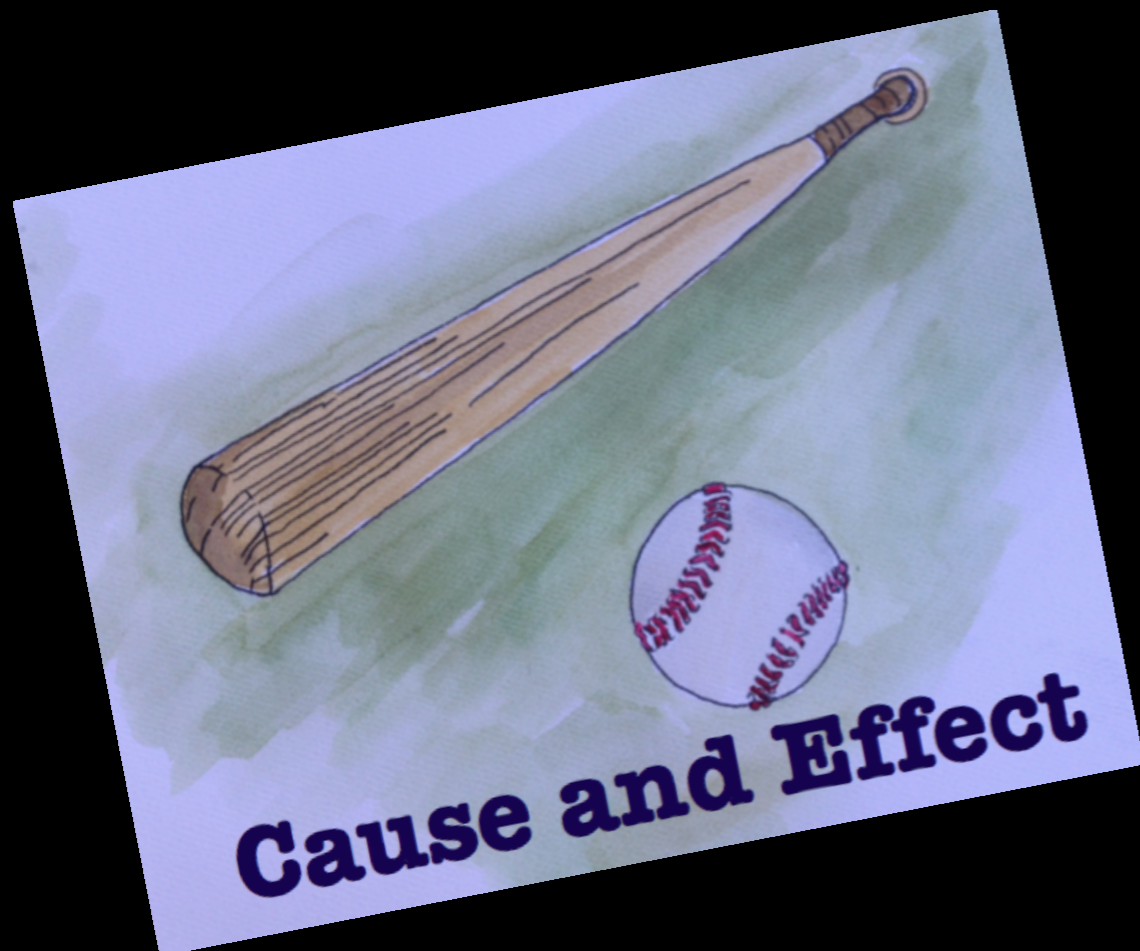
Interval Statistics

# of Intervals	100
Min	55m
Max	21h 20m
Mean	2h 33m
Median	1h 33m

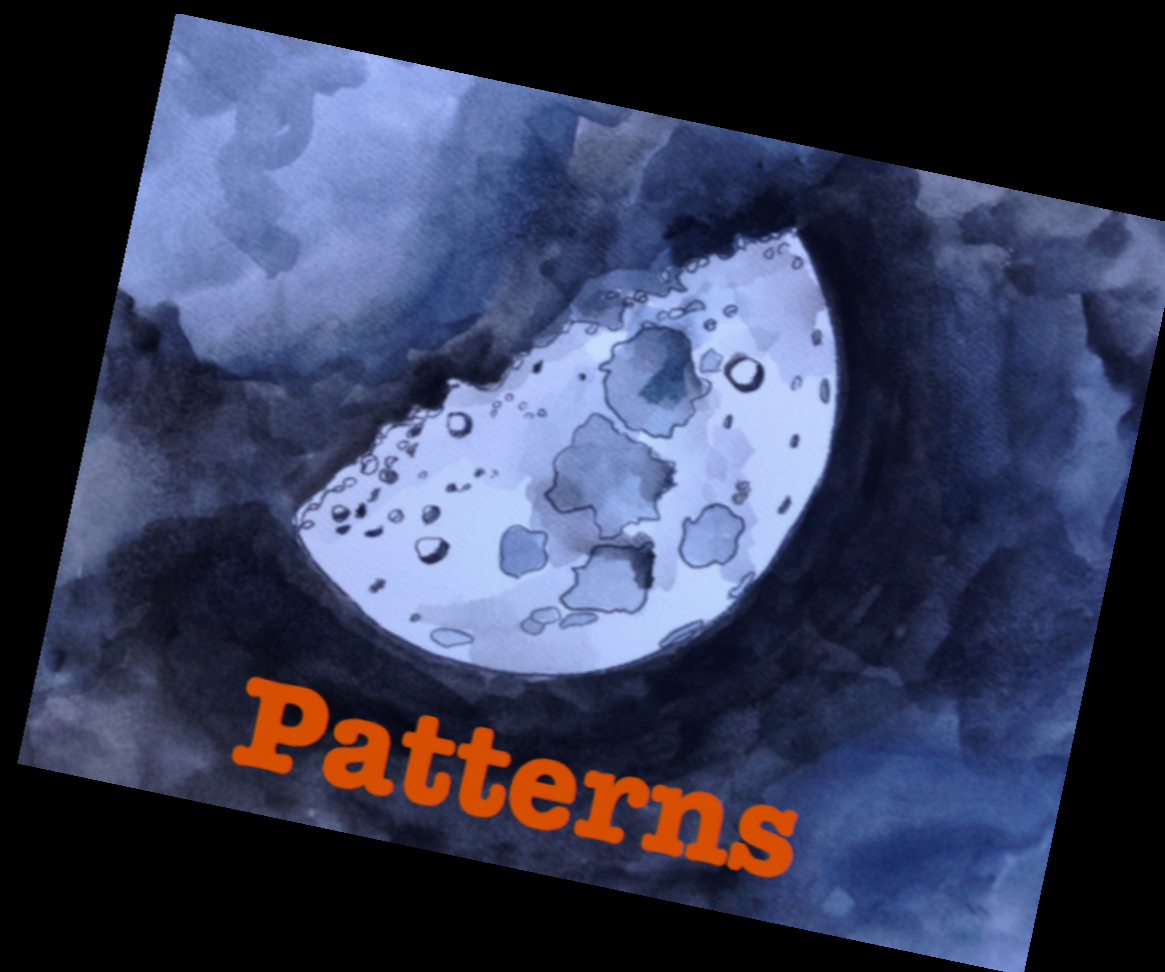
From tables to graphs



Crosscutting Concepts



Cause and Effect



Patterns

Elementary

Graph

Record Observations

Collect Data

Make Tables

Engage in Inquiry

Elementary Activity



Do you like
pumpkin seeds?

15 like
pumpkin
seeds!

17 people
tried the
seeds. $15+2=17$

2 do
not
like
pumpkin
seeds!

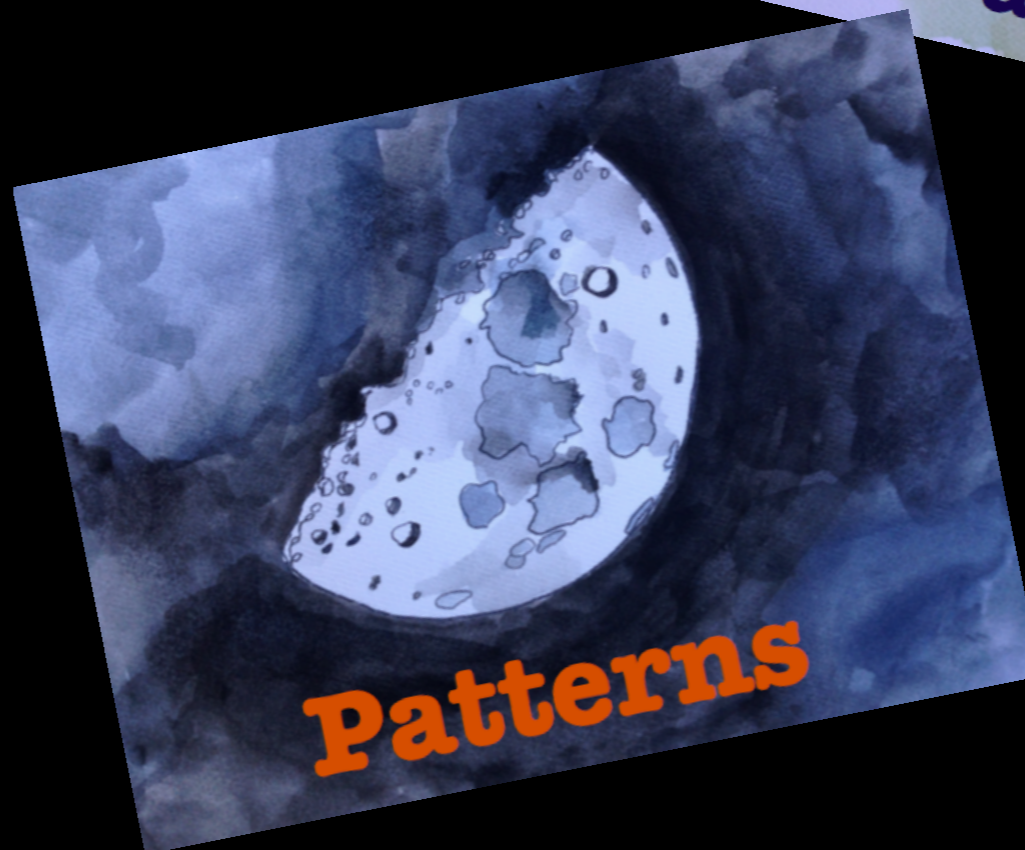
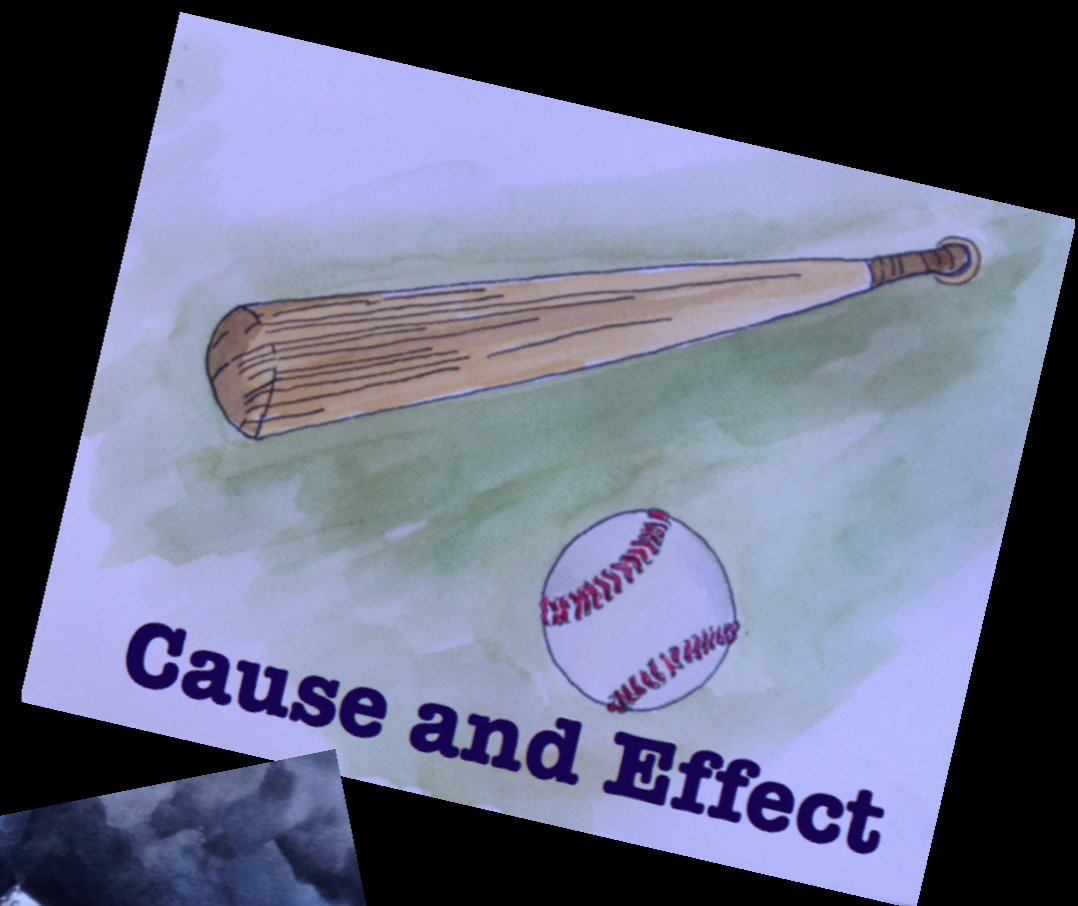
Yes please!

No thanks.

Pumpkin Seed Graph



Crosscutting Concepts



Wrap Up!

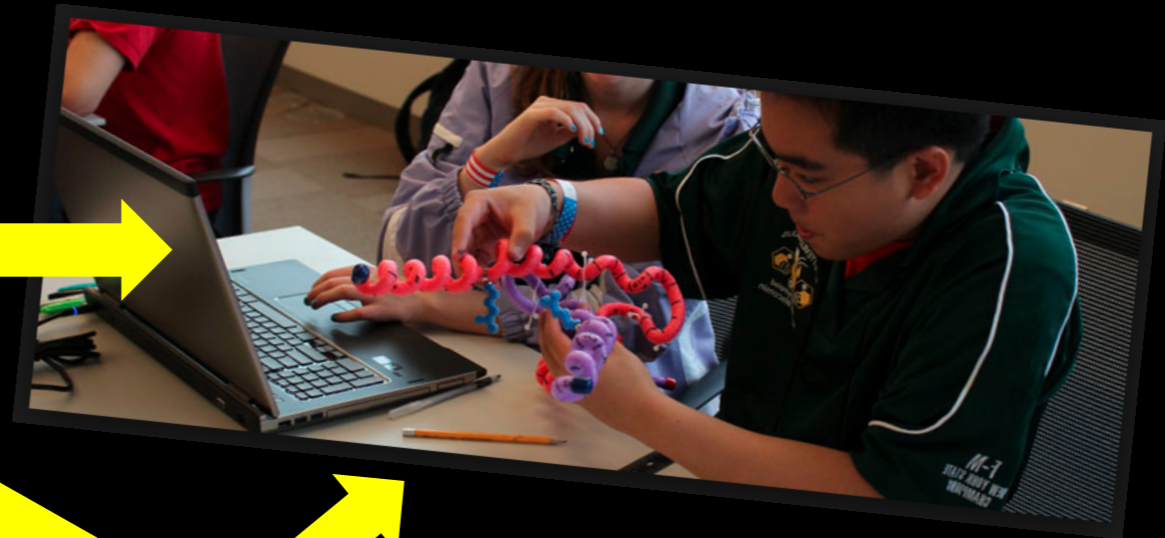
Conceptual Change...



Pierre-Auguste Renoir, The Complete Works

Interconnectedness of Practices

**Engaging
in
Argumentation**



**Analyzing
and
Interpreting
Data**

**Using
Mathematics
and
Computational
Thinking**

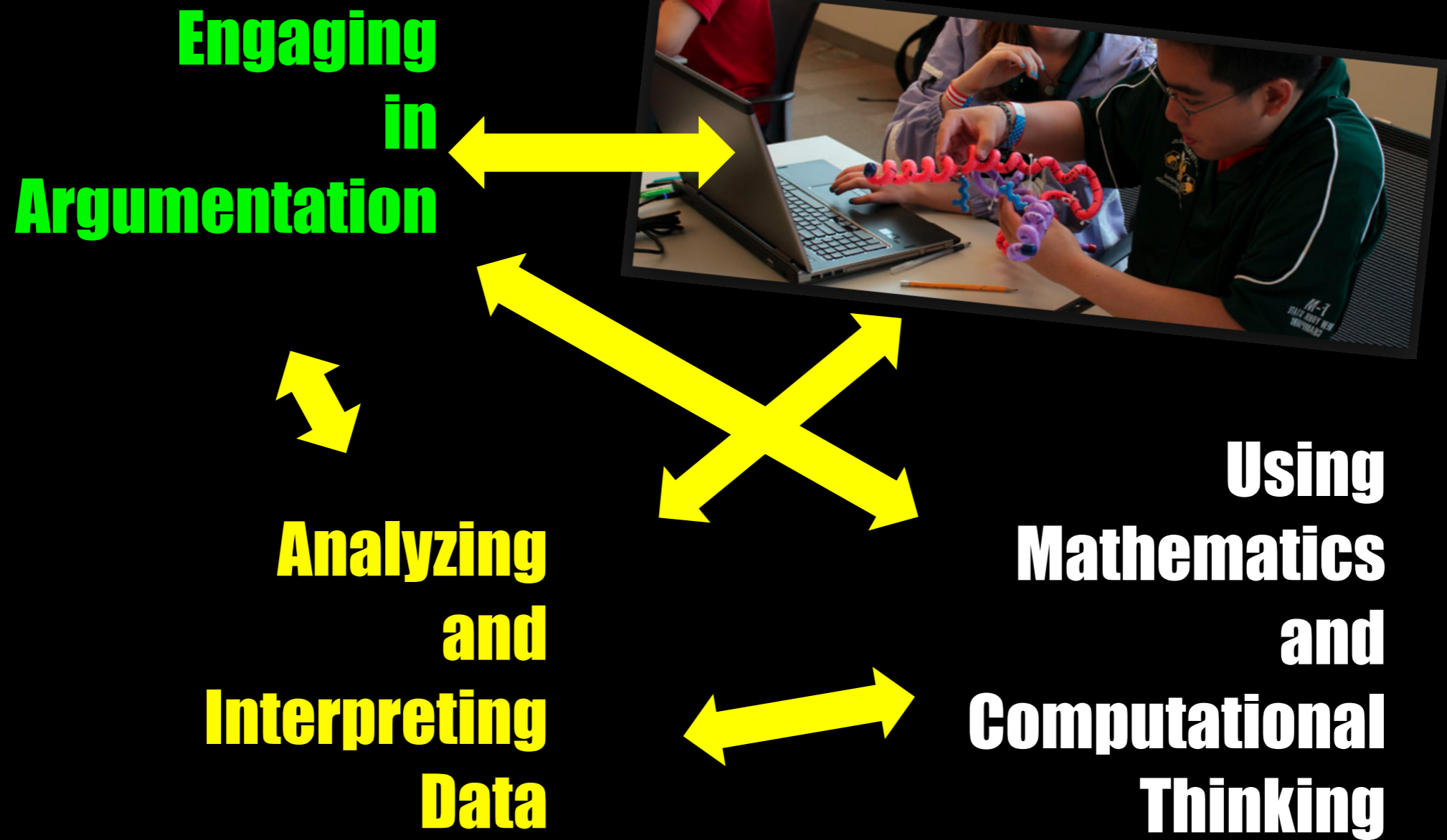
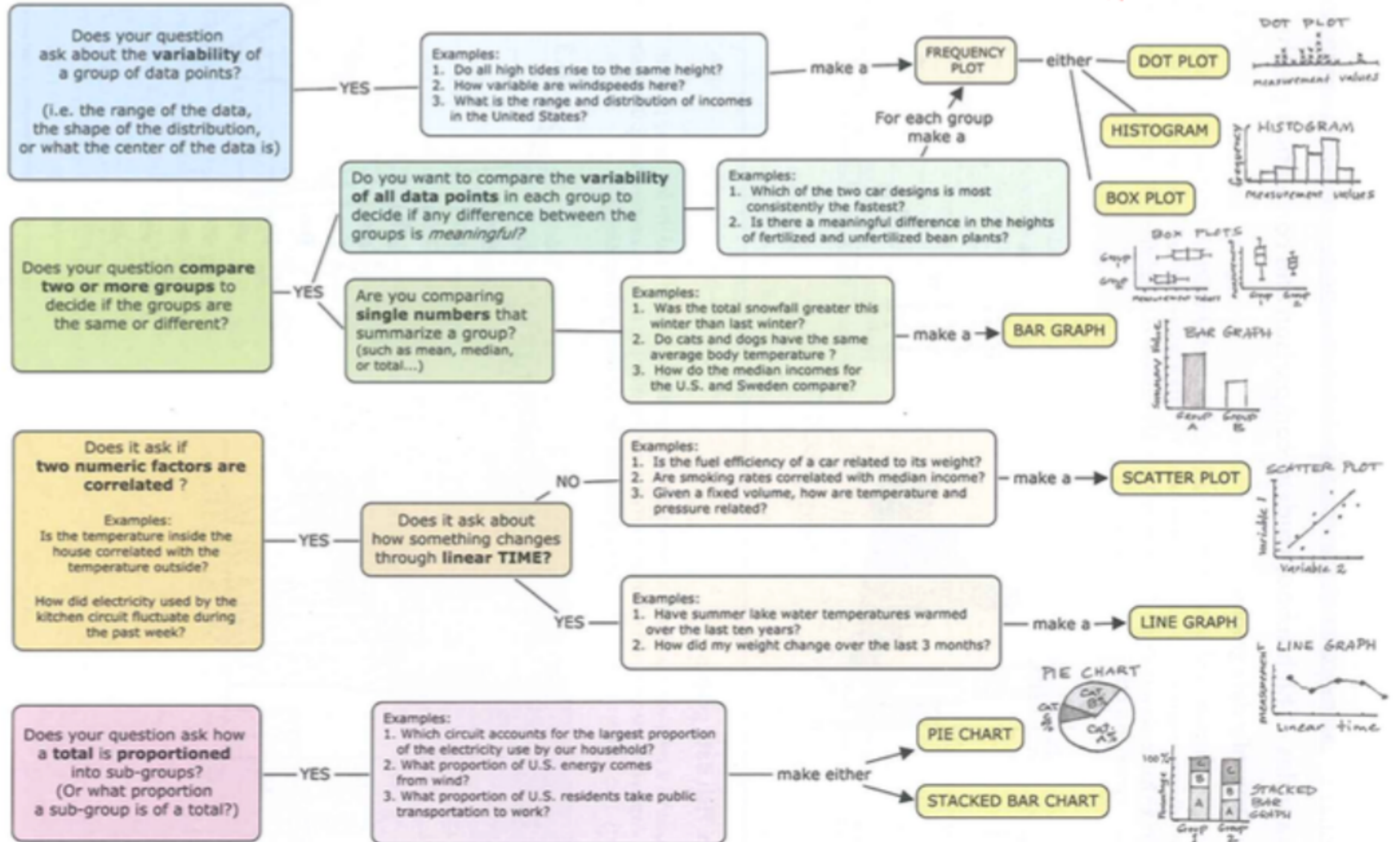


FIGURE 2

The Graph Choice Chart.

What question would you like to explore? Write your question as a complete sentence.

The Graph Choice. The Science Teacher. Nov. 2014, p. 40.



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