

Data Tables

EXAMPLE: How to Read Data Tables Correctly

The first number refers to the amount of days the plants have been in the aquariums. In the brackets, the number refers to the first half of testing (when Trials A and B were running) or the second half of testing (when Trials C and D were running).

This example:
The plants have been in this container for 7 days. This is also the second half of testing, when trials C and D were running.

This refers to the date the data was collected on.

This example:
This data was collected on November 24, 2012 (11-24-12).

This refers to the time-frame it took to collect the data.

This example:
It took from 5:02 pm to 5:28 pm to collect the data.

Test #: 7 (2)	Date: 11-24-12			Time: 5:02 pm - 5:28 pm	
Container Name	pH (units)	salinity (ppt)	gravity (unit)	temp. (Celsius)	calcium (ppm)
C-1	8.66	38	1.029	24	460
C-2	8.6	37	1.028	23	460
C-3	8.69	37	1.028	23.5	460
C-4	8.69	38	1.029	23.5	460
D-1	8.7	38	1.029	23.5	460
D-2	8.67	38	1.029	23	460
D-3	8.65	38	1.029	24.5	460
D-4	8.63	38	1.029	24.5	460

These labels are the aquarium names. The letter refers to the Trial (Trial A, B, C, or D). The number refers to the plant inside.
1= control
2=seagrass
3= sea lettuce
4= both (seagrass and sea lettuce)

This example:
This container is part of Trial D. This is the container with seagrass.

This column is where the pH values are recorded.

This example:
The pH for container D-2 is 8.67

This column is where the temperature values are recorded (in Celsius).

This example:
The temperature in D-2 is 23 degrees Celsius.

This column is where the salinity values are recorded (in ppt-parts per thousand)

This example:
The salinity level for container D-2 is 38 ppt.

This column is where the gravity values are recorded.

This example:
The gravity of D-2 is 1.029 units.

This column is where the calcium levels are recorded (in ppm-parts per million).

This example:
The calcium level for D-2 is 460 ppm.

Test #: 1 (1)	Date: 11-1-12			Time: 3:21 pm - 4:40 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.47	35.5	1.027	n/a	400
A-2	8.31	32	1.024	n/a	460
A-3	8.45	35	1.026	n/a	480
A-4	8.43	37	1.028	n/a	500
B-1	8.45	36.5	1.027	n/a	450
B-2	8.36	37	1.028	n/a	450
B-3	8.45	36.5	1.0275	n/a	480
B-4	8.45	36.5	1.0275	n/a	460

Test #: 2 (1)	Date: 11-2-12			Time: 3:07 pm - 3:55 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.45	34	1.025	23	420
A-2	8.35	36	1.027	22.5	460
A-3	8.45	36	1.027	23	460
A-4	8.47	37	1.0285	22.5	440
B-1	8.52	39	1.029	22	440
B-2	8.42	37	1.0285	22	440
B-3	8.51	36	1.027	22	470
B-4	8.47	37	1.0285	22.5	440

Test #: 3 (1)	Date: 11-3-12			Time: 12:00 pm - 12:45 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.4	37	1.028	21	450
A-2	8.43	34	1.026	20	460
A-3	8.48	36	1.027	22	480
A-4	8.49	36	1.027	20	460
B-1	8.49	36	1.027	21	470
B-2	8.44	37	1.0285	20	460
B-3	8.49	37	1.0285	21	440
B-4	8.49	36.5	1.0275	21	460

Test #: 4 (1)	Date: 11-4-12			Time: 1:58 pm - 2:34 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.43	36	1.027	24.5	480
A-2	8.44	36	1.027	25	460
A-3	8.49	37	1.028	25	460
A-4	8.49	37	1.028	24.5	440
B-1	8.55	39	1.029	25	440
B-2	8.45	37	1.028	24	440
B-3	8.47	37	1.028	25	440
B-4	8.59	37	1.028	24.5	460

Test #: 5 (1)	Date: 11-5-12			Time: 4:17 pm - 4:54 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.52	37	1.028	28.5	480
A-2	8.48	36	1.027	28.5	480
A-3	8.5	37.5	1.0285	28.5	440
A-4	8.53	38	1.029	28	480
B-1	8.6	37	1.028	28.5	460
B-2	8.43	38	1.029	28	480
B-3	8.49	37.5	1.0285	28	460
B-4	8.53	37	1.028	28	430

Test #: 6 (1)	Date: 11-6-12			Time: 5:26 pm - 5:46 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.46	35	1.026	26	480
A-2	8.48	36	1.027	25.5	n/a
A-3	8.5	36	1.027	26.5	n/a
A-4	8.51	36	1.027	26.5	n/a
B-1	8.57	37	1.028	26	n/a
B-2	8.46	38	1.029	25	n/a
B-3	8.47	37	1.029	26	n/a
B-4	8.51	38	1.029	26	n/a

Test #: 7 (1)	Date: 11-7-12			Time: 6:20 pm - 6:35 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.55	35	1.026	23	n/a
A-2	8.49	36	1.027	23	n/a
A-3	8.57	36	1.027	23	n/a
A-4	8.56	36	1.027	23	n/a
B-1	8.6	37	1.028	22	n/a
B-2	8.55	38	1.029	21	n/a
B-3	8.55	38	1.029	22	n/a
B-4	8.57	38	1.029	23	n/a

Test #: 8 (1)	Date: 11-8-12			Time: 5:40 pm - 6:08 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.48	35	1.026	24.5	420
A-2	8.48	36	1.027	25	440
A-3	8.56	38	1.029	25	440
A-4	8.51	38	1.029	24	440
B-1	8.6	38	1.029	25	440
B-2	8.49	38	1.029	24	450
B-3	8.49	38	1.029	24.5	450
B-4	8.5	36	1.027	24	440

Test #: 9 (1)	Date: 11-9-12			Time: 6:17 pm - 6:50 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.6	34	1.025	24.5	440
A-2	8.48	35	1.026	25	440
A-3	8.58	38	1.029	25	460
A-4	8.58	38	1.029	25	440
B-1	8.6	38	1.029	25	450
B-2	8.45	38	1.029	24.5	440
B-3	8.52	38	1.029	24	450
B-4	8.52	38	1.029	24.5	440

Test #: 10 (1)	Date: 11-10-12			Time: 3:25 pm - 4:35 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.45	35	1.026	21.5	440
A-2	8.48	35.5	1.0265	22	440
A-3	8.58	38	1.029	22	440
A-4	8.58	38	1.029	22	440
B-1	8.58	38	1.029	22.5	440
B-2	8.49	37	1.028	22	440
B-3	8.49	37	1.028	22	440
B-4	8.5	38	1.029	22	440

Test #: 11 (1)	Date: 11-11-12			Time: 5:27 pm - 5:45 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.58	38	1.029	21	440
A-2	8.47	36	1.027	22	440
A-3	8.54	37.5	1.0285	22	450
A-4	8.6	38	1.029	22	440
B-1	8.53	38	1.029	22	440
B-2	8.45	38	1.029	21	440
B-3	8.51	38	1.029	20	450
B-4	8.55	36	1.027	22	440

Test #: 12 (1)	Date: 11-12-12			Time: 11:26 pm - 11:47 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.44	35	1.026	19	440
A-2	8.49	35	1.026	19	440
A-3	8.6	38	1.029	19	440
A-4	8.58	38	1.029	19	440
B-1	8.6	38	1.029	19	440
B-2	8.56	37	1.028	19	440
B-3	8.54	38	1.028	19	440
B-4	8.53	37	1.028	19	440

Test #: 13 (1)	Date: 11-13-12			Time: 5:00 pm - 5:23 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.58	35	1.026	23	440
A-2	8.51	36	1.027	24	440
A-3	8.58	38	1.029	23.5	440
A-4	8.58	38	1.029	23	450
B-1	8.52	38	1.029	23	450
B-2	8.58	38	1.029	22	440
B-3	8.5	38	1.029	23	440
B-4	8.53	38	1.029	23	440

Test #: 14 (1)	Date: 11-14-12			Time: 5:00 pm - 5:41 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.61	36	1.027	22.5	440
A-2	8.52	37	1.028	23	450
A-3	8.59	38	1.029	24.5	440
A-4	8.59	38	1.029	24	460
B-1	8.54	38	1.029	24.5	460
B-2	8.58	38	1.029	24	450
B-3	8.56	38	1.029	24	440
B-4	8.53	38	1.029	24	440

Test #: 1 (2)	Date: 11-18-12			Time: 2:18 pm - 2:45 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.69	34	1.025	25	400
C-2	8.6	38	1.029	25.5	400
C-3	8.72	38	1.029	26	400
C-4	8.69	38	1.029	25	400
D-1	8.66	38	1.029	26	400
D-2	8.62	38	1.029	25	400
D-3	8.61	38	1.029	25.5	400
D-4	8.52	38	1.029	25.5	400

Test #: 2 (2)	Date: 11-19-12			Time: 4:30 pm - 4:41 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.72	38	1.029	24	n/a
C-2	8.61	38	1.029	24	n/a
C-3	8.73	38	1.029	25	n/a
C-4	8.73	38	1.029	24	n/a
D-1	8.72	38	1.029	24	n/a
D-2	8.63	38	1.029	24	n/a
D-3	8.63	38	1.029	24	n/a
D-4	8.54	38	1.029	24	n/a

Test #: 3 (2)	Date: 11-20-12			6:32 pm - 6:50 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.63	38	1.029	24	n/a
C-2	8.58	38	1.029	24.5	n/a
C-3	8.66	38	1.029	24.5	n/a
C-4	8.64	38	1.029	24.5	n/a
D-1	8.68	38	1.029	24	n/a
D-2	8.67	38	1.029	25	n/a
D-3	8.62	38	1.029	24.5	n/a
D-4	8.61	38	1.029	24.5	n/a

Test #: 4 (2)	Date: 11-21-12			Time: 5:07 pm - 5:30 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.66	38	1.029	23	460
C-2	8.6	38	1.029	24	440
C-3	8.65	38	1.029	23.5	460
C-4	8.67	38	1.029	24	460
D-1	8.65	38	1.029	23	460
D-2	8.67	38	1.029	24	440
D-3	8.63	38	1.029	24	460
D-4	8.62	37	1.028	24	460

Test #: 5 (2)	Date: 11-22-12			Time: 2:04 pm - 2:25 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.64	38	1.029	23	460
C-2	8.59	38	1.029	22	460
C-3	8.67	38	1.029	23	460
C-4	8.66	38	1.029	22.5	460
D-1	8.66	38	1.029	23	460
D-2	8.68	38	1.029	22	460
D-3	8.64	38	1.029	22.5	460
D-4	8.68	38	1.029	23	460

Test #: 6 (2)	Date: 11-23-12			Time: 4:20 pm - 4:50 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.65	38	1.029	24.5	460
C-2	8.6	35	1.026	24	460
C-3	8.68	37	1.028	24.5	460
C-4	8.66	38	1.029	23	460
D-1	8.7	38	1.029	23	460
D-2	8.65	38	1.029	24	460
D-3	8.65	38	1.029	22.5	460
D-4	8.63	37	1.028	25	460

Test #: 7 (2)	Date: 11-24-12			Time: 5:02 pm - 5:28 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.66	38	1.029	24	460
C-2	8.6	37	1.028	23	460
C-3	8.69	37	1.028	23.5	460
C-4	8.69	38	1.029	23.5	460
D-1	8.7	38	1.029	23.5	460
D-2	8.67	38	1.029	23	460
D-3	8.65	38	1.029	24.5	460
D-4	8.63	38	1.029	24.5	460

Test #: 8 (2)	Date: 11-25-12			Time: 2:25 pm - 2:42 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.69	37	1.028	23	460
C-2	8.6	35.5	1.0265	22.5	460
C-3	8.7	38	1.029	23	460
C-4	8.69	37.5	1.0285	23	460
D-1	8.71	38	1.029	23.5	460
D-2	8.67	38	1.029	22.5	460
D-3	8.66	38	1.029	23	460
D-4	8.64	37.5	1.0285	23	460

Test #: 9 (2)	Date: 11-26-12			Time: 5:07 pm - 5: 29 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.65	36	1.027	24	480
C-2	8.63	36	1.027	24	480
C-3	8.7	37	1.028	24	460
C-4	8.69	38	1.029	24.5	470
D-1	8.72	38	1.029	24	480
D-2	8.64	38	1.029	23.4	480
D-3	8.64	38	1.029	24	460
D-4	8.64	38	1.029	24	470

Test #: 10 (2)	Date: 11-27-12			Time: 7:39 pm - 8:00 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.67	36	1.027	24	480
C-2	8.62	35.5	1.0265	23.5	480
C-3	8.7	37	1.028	24	460
C-4	8.69	38	1.029	24.5	460
D-1	8.69	38	1.029	24.5	460
D-2	8.6	38	1.029	24	470
D-3	8.61	38	1.029	25	460
D-4	8.59	37.5	1.0285	23.5	470

Test #: 11 (2)	Date: 11-28-12			Time: 4:32 pm - 4:45 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.71	37	1.028	24	470
C-2	38	37	1.028	23	470
C-3	8.7	38	1.029	23.5	460
C-4	8.7	38	1.029	24	460
D-1	8.66	38	1.029	24	460
D-2	8.61	38	1.029	23.5	460
D-3	8.61	38	1.029	23	460
D-4	8.58	38	1.029	24	460

Test #: 12 (2)	Date: 11-29-12			Time: 5:46 pm - 6:01 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.71	36	1.027	24	460
C-2	8.6	37	1.028	24.5	460
C-3	8.69	38	1.029	24.5	470
C-4	8.68	38	1.029	24	460
D-1	8.65	38	1.029	25	460
D-2	8.6	38	1.029	24	470
D-3	8.6	38	1.029	24	470
D-4	8.6	38	1.029	25	460

Test #: 13 (2)	Date: 11-30-12			Time: 5:30 pm - 5:44 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.6	37	1.028	24.5	460
C-2	8.63	37	1.028	24.5	460
C-3	8.6	38	1.029	25	460
C-4	8.6	38	1.029	24.5	460
D-1	8.66	38	1.029	25	460
D-2	8.6	36	1.027	24	460
D-3	8.61	38	1.029	24.5	460
D-4	8.61	37	1.028	24.5	460

Test #: 14 (2)	Date: 12-1-12			Time: 1:45 pm - 2:42 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
C-1	8.62	37	1.028	23.5	440
C-2	8.58	37	1.028	22.5	460
C-3	8.68	38	1.029	23	420
C-4	8.63	38	1.029	22.5	460
D-1	8.65	38	1.029	23.5	400
D-2	8.6	38	1.029	22	460
D-3	8.62	38	1.029	23	460
D-4	8.62	37.5	1.0285	23	440

Observations

This experiment was conducted to see if seagrass and sea lettuce, two different oceanic plants could reduce ocean acidity. For this experiment, it took a total of four containers to carry out one trial. The first aquarium didn't have any plants inside for it served as the control. The second aquarium had seagrass while the third had sea lettuce. In the final container, both seagrass and sea lettuce were combined. The tests were run for two weeks to see if over this period of time the plants had an effect on the water's pH, the primary variable. Salinity, specific gravity, calcium and temperature were also recorded, as sanity variables, to make sure the oceanic conditions are within the coral reef environmental range. Eight containers were used in order to have two trials run in parallel. This was done in order to collect more data.

pH was recorded by using a pH monitor. When measuring the pH throughout the experiment, it was noted that the pH was normally around the 8.5 mark. This was surprising in the beginning of testing when it was thought that the pH would be closer to 8.2, the general oceanic pH. The control's pH seemed to bounce around follow no particular pattern. Some days the pH was relatively high and other times it would drop as much as 0.4 units. On the other hand, the containers with plants seemed to be increasing at a slow rate. Trials A and B have more active trend lines, where as Trial C and D are more subtle.

Salinity and specific gravity were recorded using the same device, an ocean hydrometer. The natural salinity level is suppose to be 35ppt. The salinity trend levels ranged between 32ppt and 39ppt. In every trial a similar factor occurred in which salt particles formed on the lids and even on the tables. This was an interesting observation also because the sea lettuce containers seemed to accumulate the most salt. Since salinity and specific gravity are water conditions that should stay relatively the same, they are being recorded as sanity variables to make sure the ocean water does not reach extremes. The overall salinity levels were in a close enough range to represent a coral reef environment. The specific gravity, a comparison of the density to regular water stayed quite consistent throughout, ranging from 1.024-1.029. This also stayed in regular oceanic water conditions.

Temperature was measured using a basic thermometer. The water temperatures reached as low as 19 degrees Celsius on one day, and as high as 28 degrees Celsius on another, however the majority of the time, the water temperature was in-between 23-25 degrees Celsius. The

average water temperature for coral reefs is between 23.3-28.9 degrees Celsius. Therefore the temperature was in the correct range as well.

The final parameter measured was calcium. The natural calcium level is 420ppm, however research has stated that staying between the range of 380ppm-450ppm are suitable as well. The interesting factor about calcium levels are that lower calcium levels will negatively impact the marine environment; however calcium levels higher than 450 do not impact the plants the plants anyway. There are some breaks in the calcium trend lines because this data couldn't be recorded on a few days, due to a lack of calcium test solution. The range of calcium levels in this experiment were from 400-490. Even though this might seem like a big range, the calcium level did not drop below 380 which is the true issue.

It was observed that seagrass plants did not do nearly as well as sea lettuce plants. After around nine to ten days in the aquariums, the seagrass plants began to turn brown and look more wilted. Therefore at the half point of testing, when Trials A and B finished and Trials C and D began, the seagrass plants had to be replaced with healthier ones. This same observation also occurred with Trial C and D. On the other hand, the sea lettuce plants seemed to prosper throughout all the trials. The plants never showed distress unlike the seagrass plants.

The hypothesis for this experiment was that each of tanks will start with an initial pH of 8.0 units. The container with seagrass is predicted to increase the pH 0.25 units by the end of the experiment, resulting in a pH of 8.25. The container with sea lettuce is predicted to increase the water level 0.15 units, ending at 8.15. The last of the containers, containing both seagrass and sea lettuce is thought to have an overall increase of 0.20 units in pH with the outcome of 8.20 pH units. This hypothesis was entirely wrong from the beginning to the end of testing. The data collected in this experiment showed that the control fluctuated whereas when plants are added to an aquarium (or in the ocean) an increasing pH rate is established.

