

## Library 312

#	Date/Time	CO2 (ppm)
1	4/1/2016 11:41	654.5
2	4/1/2016 11:42	682.5
3	4/1/2016 11:43	636.1
4	4/1/2016 11:44	406
5	4/1/2016 11:45	402.9
6	4/1/2016 11:46	409.6
7	4/1/2016 11:47	382.2
8	4/1/2016 11:48	385.8
9	4/1/2016 11:49	378.5
10	4/1/2016 11:50	386.4
11	4/1/2016 11:51	449.9
12	4/1/2016 11:52	544.6
13	4/1/2016 11:53	562.3
14	4/1/2016 11:54	550.7
15	4/1/2016 11:55	557.4
16	4/1/2016 11:56	573.3
17	4/1/2016 11:57	617.8
18	4/1/2016 11:58	623.3
19	4/1/2016 11:59	640.4
20	4/1/2016 12:00	641
21	4/1/2016 12:01	642.9
22	4/1/2016 12:02	659.3
23	4/1/2016 12:03	670.9
24	4/1/2016 12:04	683.8
25	4/1/2016 12:05	700.9
26	4/1/2016 12:06	710.6
27	4/1/2016 12:07	679.5
28	4/1/2016 12:08	704.5
29	4/1/2016 12:09	703.3
30	4/1/2016 12:10	711.2
31	4/1/2016 12:11	734.4
32	4/1/2016 12:12	744.2
33	4/1/2016 12:13	733.8
34	4/1/2016 12:14	728.3
35	4/1/2016 12:15	766.8
36	4/1/2016 12:16	768
37	4/1/2016 12:17	774.7
38	4/1/2016 12:18	735.7
39	4/1/2016 12:19	736.9
40	4/1/2016 12:20	772.9
41	4/1/2016 12:21	735.7
42	4/1/2016 12:22	727.7
43	4/1/2016 12:23	747.3
44	4/1/2016 12:24	721.6
45	4/1/2016 12:25	703.3

46	4/1/2016 12:26	701.5			
47	4/1/2016 12:27	706.3			
48	4/1/2016 12:28	701.5			
49	4/1/2016 12:29	694.7			
50	4/1/2016 12:30	658.7			
51	4/1/2016 12:31	667.9			
52	4/1/2016 12:32	660			
53	4/1/2016 12:33	641			
54	4/1/2016 12:34	632.5			
55	4/1/2016 12:35	619.7			
56	4/1/2016 12:36	623.3			
57	4/1/2016 12:37	638.6			
58	4/1/2016 12:38	628.8			
59	4/1/2016 12:39	605.6			
60	4/1/2016 12:40	606.8			
61	4/1/2016 12:41	580			
62	4/1/2016 12:42	586.1			
63	4/1/2016 12:43	586.1			
64	4/1/2016 12:44	576.9			
65	4/1/2016 12:45	580			
66	4/1/2016 12:46	576.3			
67	4/1/2016 12:47	569.6			
68	4/1/2016 12:48	568.4			
69	4/1/2016 12:49	553.7			
70	4/1/2016 12:50	562.3			
71	4/1/2016 12:51	555.6			
72	4/1/2016 12:52	561.7			
73	4/1/2016 12:53	551.3			
74	4/1/2016 12:54	541.5			
75	4/1/2016 12:55	553.7			
76	4/1/2016 12:56	553.1			
77	4/1/2016 12:57	543.3			
78	4/1/2016 12:58	529.3			
79	4/1/2016 12:59	584.2			
80	4/1/2016 13:00	559.8			
81	4/1/2016 13:01	428			
82	4/1/2016 13:02	404.8			
83	4/1/2016 13:03	434.1			
84	4/1/2016 13:04	366.9			
85	4/1/2016 13:05	389.5			
86	4/1/2016 13:05		Logged		
87	4/1/2016 13:06			Logged	Logged

Steven Hoper  
ENGR 115  
11:00 Lab  
4/1/2016

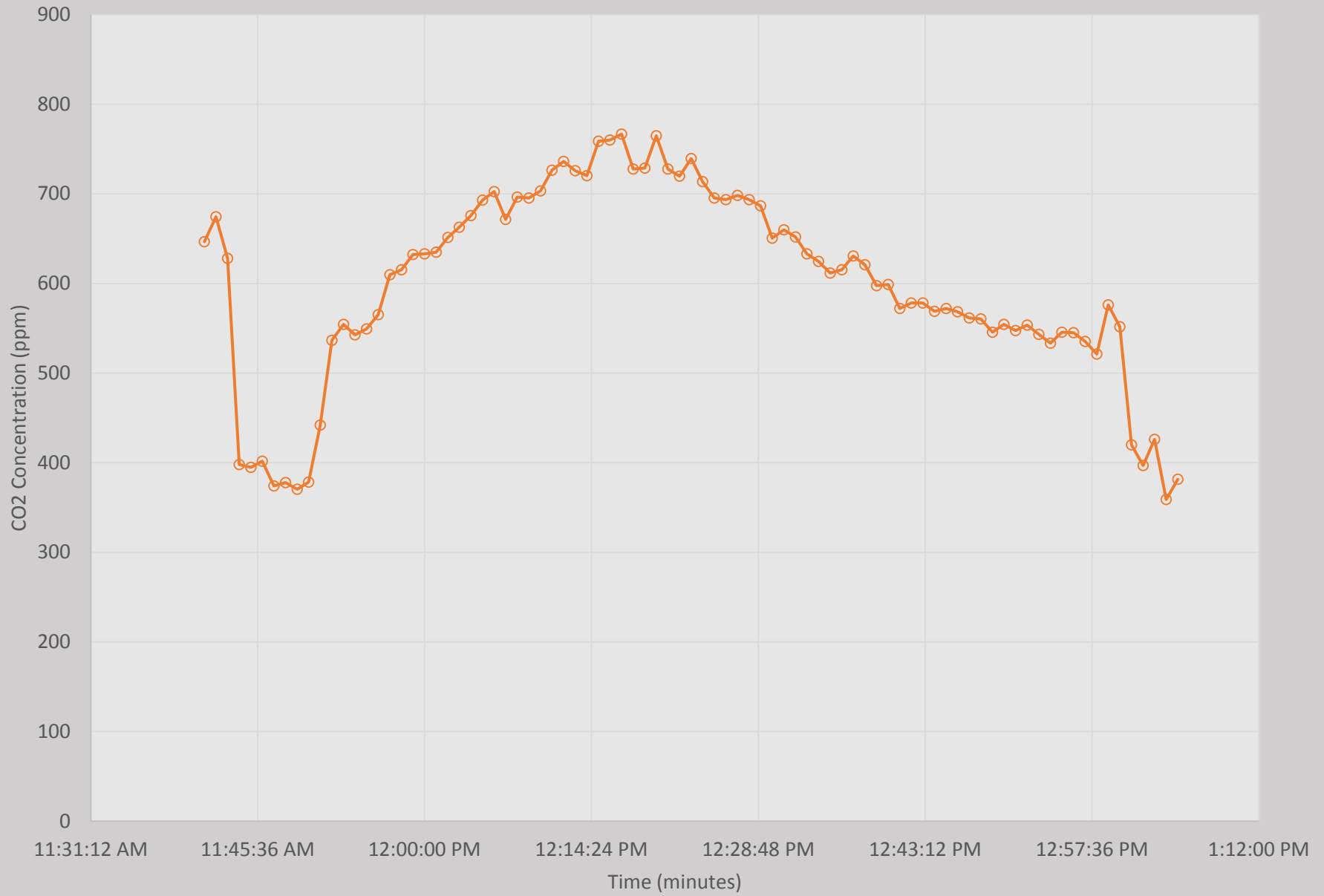
Input Parameters	Column1
Measured Outdoor (ppm)	408
Assumed Outdoor (ppm)	400
Correction Factor	8

#### Analysis

Measurement	Date	Date/Time	Hobo CO2 Concentration	Actual CO2 Concentration (ppm)
1	4/1/2016	11:41:00 AM	654.5	646.5
2	4/1/2016	11:42:00 AM	682.5	674.5
3	4/1/2016	11:43:00 AM	636.1	628.1
4	4/1/2016	11:44:00 AM	406	398
5	4/1/2016	11:45:00 AM	402.9	394.9
6	4/1/2016	11:46:00 AM	409.6	401.6
7	4/1/2016	11:47:00 AM	382.2	374.2
8	4/1/2016	11:48:00 AM	385.8	377.8
9	4/1/2016	11:49:00 AM	378.5	370.5
10	4/1/2016	11:50:00 AM	386.4	378.4
11	4/1/2016	11:51:00 AM	449.9	441.9
12	4/1/2016	11:52:00 AM	544.6	536.6
13	4/1/2016	11:53:00 AM	562.3	554.3
14	4/1/2016	11:54:00 AM	550.7	542.7
15	4/1/2016	11:55:00 AM	557.4	549.4
16	4/1/2016	11:56:00 AM	573.3	565.3
17	4/1/2016	11:57:00 AM	617.8	609.8
18	4/1/2016	11:58:00 AM	623.3	615.3
19	4/1/2016	11:59:00 AM	640.4	632.4
20	4/1/2016	12:00:00 PM	641	633
21	4/1/2016	12:01:00 PM	642.9	634.9
22	4/1/2016	12:02:00 PM	659.3	651.3
23	4/1/2016	12:03:00 PM	670.9	662.9
24	4/1/2016	12:04:00 PM	683.8	675.8
25	4/1/2016	12:05:00 PM	700.9	692.9
26	4/1/2016	12:06:00 PM	710.6	702.6
27	4/1/2016	12:07:00 PM	679.5	671.5
28	4/1/2016	12:08:00 PM	704.5	696.5
29	4/1/2016	12:09:00 PM	703.3	695.3
30	4/1/2016	12:10:00 PM	711.2	703.2
31	4/1/2016	12:11:00 PM	734.4	726.4
32	4/1/2016	12:12:00 PM	744.2	736.2
33	4/1/2016	12:13:00 PM	733.8	725.8
34	4/1/2016	12:14:00 PM	728.3	720.3
35	4/1/2016	12:15:00 PM	766.8	758.8
36	4/1/2016	12:16:00 PM	768	760
37	4/1/2016	12:17:00 PM	774.7	766.7
38	4/1/2016	12:18:00 PM	735.7	727.7
39	4/1/2016	12:19:00 PM	736.9	728.9
40	4/1/2016	12:20:00 PM	772.9	764.9
41	4/1/2016	12:21:00 PM	735.7	727.7
42	4/1/2016	12:22:00 PM	727.7	719.7
43	4/1/2016	12:23:00 PM	747.3	739.3
44	4/1/2016	12:24:00 PM	721.6	713.6
45	4/1/2016	12:25:00 PM	703.3	695.3
46	4/1/2016	12:26:00 PM	701.5	693.5
47	4/1/2016	12:27:00 PM	706.3	698.3
48	4/1/2016	12:28:00 PM	701.5	693.5
49	4/1/2016	12:29:00 PM	694.7	686.7
50	4/1/2016	12:30:00 PM	658.7	650.7
51	4/1/2016	12:31:00 PM	667.9	659.9

52	4/1/2016	12:32:00 PM	660	652
53	4/1/2016	12:33:00 PM	641	633
54	4/1/2016	12:34:00 PM	632.5	624.5
55	4/1/2016	12:35:00 PM	619.7	611.7
56	4/1/2016	12:36:00 PM	623.3	615.3
57	4/1/2016	12:37:00 PM	638.6	630.6
58	4/1/2016	12:38:00 PM	628.8	620.8
59	4/1/2016	12:39:00 PM	605.6	597.6
60	4/1/2016	12:40:00 PM	606.8	598.8
61	4/1/2016	12:41:00 PM	580	572
62	4/1/2016	12:42:00 PM	586.1	578.1
63	4/1/2016	12:43:00 PM	586.1	578.1
64	4/1/2016	12:44:00 PM	576.9	568.9
65	4/1/2016	12:45:00 PM	580	572
66	4/1/2016	12:46:00 PM	576.3	568.3
67	4/1/2016	12:47:00 PM	569.6	561.6
68	4/1/2016	12:48:00 PM	568.4	560.4
69	4/1/2016	12:49:00 PM	553.7	545.7
70	4/1/2016	12:50:00 PM	562.3	554.3
71	4/1/2016	12:51:00 PM	555.6	547.6
72	4/1/2016	12:52:00 PM	561.7	553.7
73	4/1/2016	12:53:00 PM	551.3	543.3
74	4/1/2016	12:54:00 PM	541.5	533.5
75	4/1/2016	12:55:00 PM	553.7	545.7
76	4/1/2016	12:56:00 PM	553.1	545.1
77	4/1/2016	12:57:00 PM	543.3	535.3
78	4/1/2016	12:58:00 PM	529.3	521.3
79	4/1/2016	12:59:00 PM	584.2	576.2
80	4/1/2016	1:00:00 PM	559.8	551.8
81	4/1/2016	1:01:00 PM	428	420
82	4/1/2016	1:02:00 PM	404.8	396.8
83	4/1/2016	1:03:00 PM	434.1	426.1
84	4/1/2016	1:04:00 PM	366.9	358.9
85	4/1/2016	1:05:00 PM	389.5	381.5

Actual CO2 Concentration Over Time



Steven Hoper  
ENGR 115  
11:00 Lab  
4/1/2016

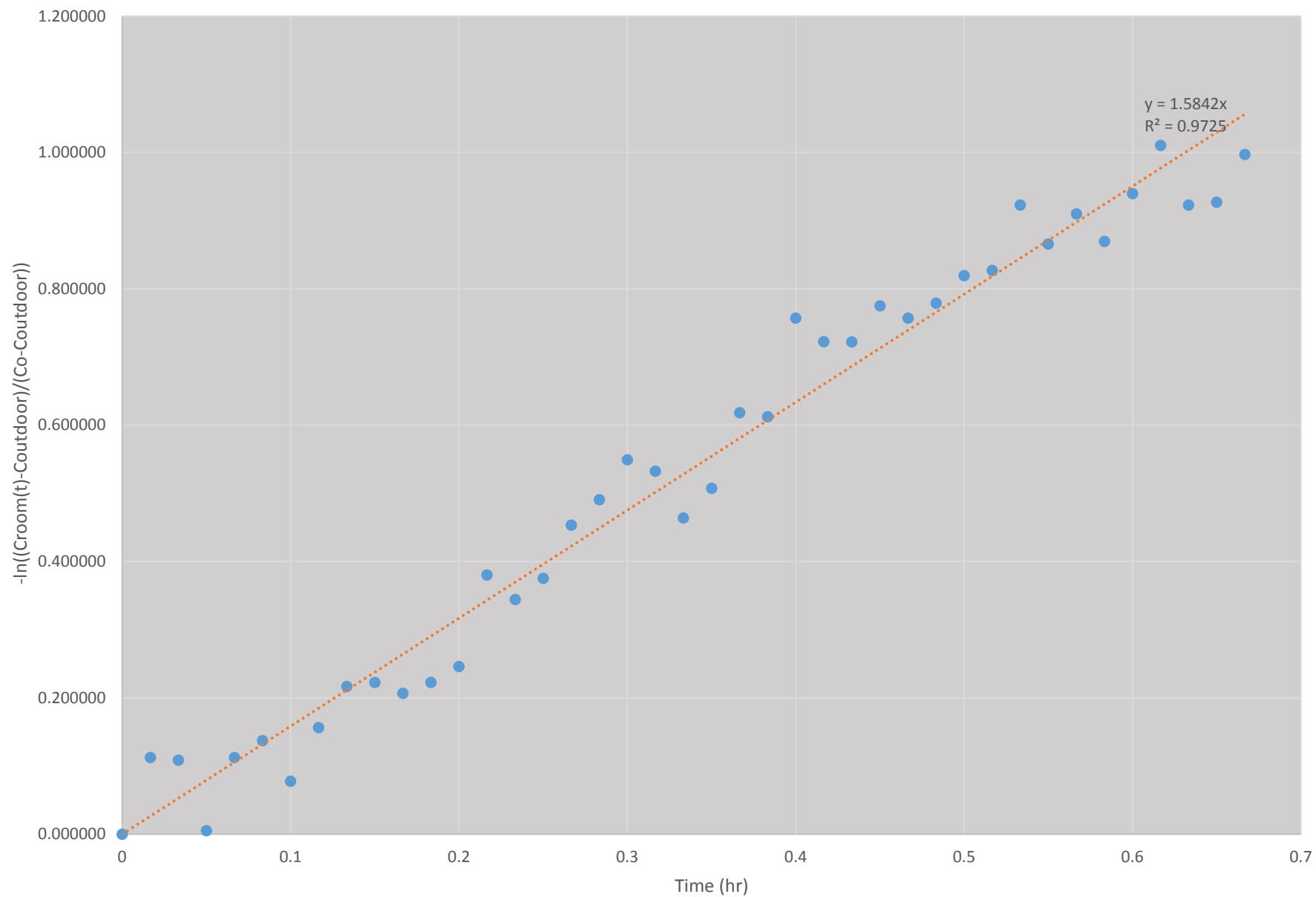
Input Parameters	Column1
Measured Outdoor (ppm)	408
Assumed Outdoor (ppm)	400
Correction Factor	8
Room Volume (ft^3)	2194.5
Room Capacity (People)	4

Calculations:	Column2
Air exchange rate [1/hr]	1.5842
Time to remove non-reactive chemical [hr]	1.8937
Ventilation Rate [ft^3/min/person]	14.5

Analysis

Measurement	Date	Date/Time	Hobo CO2 Concentration	Actual CO2 Concentration (ppm)	Experiment Time [hr]	Equation: $-\ln((C_{room}(t)-C_{outdoor})/(C_{room}(0)-C_{outdoor}))$	
	0	4/1/2016	12:17:00 PM	774.7	766.7	0	0.000000
	1	4/1/2016	12:18:00 PM	735.7	727.7	0.017	0.112446
	2	4/1/2016	12:19:00 PM	736.9	728.9	0.033	0.108790
	3	4/1/2016	12:20:00 PM	772.9	764.9	0.050	0.004921
	4	4/1/2016	12:21:00 PM	735.7	727.7	0.067	0.112446
	5	4/1/2016	12:22:00 PM	727.7	719.7	0.083	0.137161
	6	4/1/2016	12:23:00 PM	747.3	739.3	0.100	0.077659
	7	4/1/2016	12:24:00 PM	721.6	713.6	0.117	0.156426
	8	4/1/2016	12:25:00 PM	703.3	695.3	0.133	0.216552
	9	4/1/2016	12:26:00 PM	701.5	693.5	0.150	0.222666
	10	4/1/2016	12:27:00 PM	706.3	698.3	0.167	0.206444
	11	4/1/2016	12:28:00 PM	701.5	693.5	0.183	0.222666
	12	4/1/2016	12:29:00 PM	694.7	686.7	0.200	0.246108
	13	4/1/2016	12:30:00 PM	658.7	650.7	0.217	0.380287
	14	4/1/2016	12:31:00 PM	667.9	659.9	0.233	0.344247
	15	4/1/2016	12:32:00 PM	660	652	0.250	0.375115
	16	4/1/2016	12:33:00 PM	641	633	0.267	0.453506
	17	4/1/2016	12:34:00 PM	632.5	624.5	0.283	0.490668
	18	4/1/2016	12:35:00 PM	619.7	611.7	0.300	0.549374
	19	4/1/2016	12:36:00 PM	623.3	615.3	0.317	0.532512
	20	4/1/2016	12:37:00 PM	638.6	630.6	0.333	0.463859
	21	4/1/2016	12:38:00 PM	628.8	620.8	0.350	0.507287
	22	4/1/2016	12:39:00 PM	605.6	597.6	0.367	0.618299
	23	4/1/2016	12:40:00 PM	606.8	598.8	0.383	0.612245
	24	4/1/2016	12:41:00 PM	580	572	0.400	0.757050
	25	4/1/2016	12:42:00 PM	586.1	578.1	0.417	0.722199
	26	4/1/2016	12:43:00 PM	586.1	578.1	0.433	0.722199
	27	4/1/2016	12:44:00 PM	576.9	568.9	0.450	0.775237
	28	4/1/2016	12:45:00 PM	580	572	0.467	0.757050
	29	4/1/2016	12:46:00 PM	576.3	568.3	0.483	0.778796
	30	4/1/2016	12:47:00 PM	569.6	561.6	0.500	0.819420
	31	4/1/2016	12:48:00 PM	568.4	560.4	0.517	0.826873
	32	4/1/2016	12:49:00 PM	553.7	545.7	0.533	0.922994
	33	4/1/2016	12:50:00 PM	562.3	554.3	0.550	0.865645
	34	4/1/2016	12:51:00 PM	555.6	547.6	0.567	0.910038
	35	4/1/2016	12:52:00 PM	561.7	553.7	0.583	0.869541
	36	4/1/2016	12:53:00 PM	551.3	543.3	0.600	0.939604
	37	4/1/2016	12:54:00 PM	541.5	533.5	0.617	1.010443
	38	4/1/2016	12:55:00 PM	553.7	545.7	0.633	0.922994
	39	4/1/2016	12:56:00 PM	553.1	545.1	0.650	0.927121
	40	4/1/2016	12:57:00 PM	543.3	535.3	0.667	0.997050

## Determining Air Exchange In A Library Study Room



1. What is the air exchange rate ( $\lambda$ ) of the room you tested? Be sure to include the units for the air exchange rate in your answer.
- Our room exchanges air at a rate of about 1.6 of the total vol/hr. Out Ventilation rate comes out as 14.5 ft<sup>3</sup>/min/person
2. In general it takes  $3/\lambda$  hours to remove a non-reactive chemical from indoor air. Based on this time, what recommendations would you make to the occupants of the room?
- I would advise the people in the room to either cut down on their numbers, slow their respiration, or spend less time all together in the room. However the most efficient option would be to simply increase ventilation.
3. Compare your ventilation rate for a typical number of occupants to the ASHRAE recommended ventilation rate. Based on this comparison, are the occupants wasting energy heating and cooling the air or are the occupants being too cheap and not supplying enough air? Justify your answer.
- ASHRAE guidelines recommend 15 ft<sup>3</sup>/min/person, whereas our library room has a rate of 14.5 ft<sup>3</sup>/min/person. Therefore the library room is below the recommended standard for ventilation. As far as heating and cooling are concerned, the library room would retain desired temperature for longer due to its lower air flow.
4. Given the ASHRAE standard ventilation standard, what is the maximum number of people you would recommend having in this room at one time? Use your model to determine this number.
- I wouldn't exceed four people in the room at any given time. When factoring a population of four into our existing model we come back with a ventilation rate that is slightly below the ASHRAE standard. Therefore if any more people are added to the room the CO<sub>2</sub> emitted will quickly build up before it can be removed.