Supplemental Material

CBE—Life Sciences Education

Angra and Gardner

Supplemental Materials, Table 1. Bacterial growth and plant leaves graphing scenarios

Bacterial growth scenario

Imagine you are a microbiologist. You are particularly intrigued by how temperature affects the growth of bacteria. In order to answer your question, you set up an experiment that measures the growth of a particular type of bacteria at two different temperatures. You collect your data and display it in a chart shown below:

	Number of Cells					
Time (min)	22 °C			10°C		
	Tube 1	Tube 2	Tube 3	Tube 1	Tube 2	Tube 3
0	2	2	1	2	1	2
30	4	4	3	2	2	3
60	6	8	6	2	2	3
90	12	16	12	2	3	4
120	24	30	22	4	5	6

Plant leaves scenario

Imagine you are a botanist. You are particularly intrigued by how the amount of water influences plant growth. In order to answer your question, you set up an experiment that measures the growth of a particular type of plant at two different water amounts. You collect your data and display it in a chart shown below:

	Number of Leaves					
Time (Hours)	15 ml of water/day			5ml of water/day		
	Plant 1	Plant 2	Plant 3	Plant 1	Plant 2	Plant 3
0	0	1	0	0	0	0
30	2	1	3	0	1	1
60	3	3	5	2	1	2
90	4	3	5	2	1	3
120	6	5	7	3	1	4

Supplemental Materials, Table 2. Demographic information for undergraduate participants

Participant Code	Scenario	Year in College	Major Track	Past Research Experience?
UGNR 1	Bacteria	2nd	General	No
UGNR 2	Plant	2nd	Cell, molecular, development	No
UGNR 3	Plant	1st	Genetics	No
UGNR 4	Bacteria	1st	Genetics	No
UGNR 5	Plant	1st	Biochemistry	No
UGNR 6	Plant	1st	General	No
UGNR 7	Bacteria	3rd	Neurobiology, physiology	No
UGNR 8	Bacteria	1st	General	No
UGNR 9	Bacteria	2nd	General	No
UGNR 10	Plant	3rd	Biochemistry	No
UGR 1	Plant	4th	Cell, molecular, development	Yes, 4 semesters of research, visual images, cell counts, growth rates
UGR 2	Bacteria	4th	Genetics	Yes, results of gels and drosophila crosses
UGR 3	Bacteria	4th	General	Yes, cell count and analysis
UGR 4	Plant	1st	Neurobiology, physiology	Yes, unpaid internship, neuron feedback from cockroaches
UGR 5	Plant	4th	Neurobiology, physiology	Yes, two years of research, population measurements of cellular growth and intensity values

Supplemental Materials, Table 3. Demographic information for graduate student participants

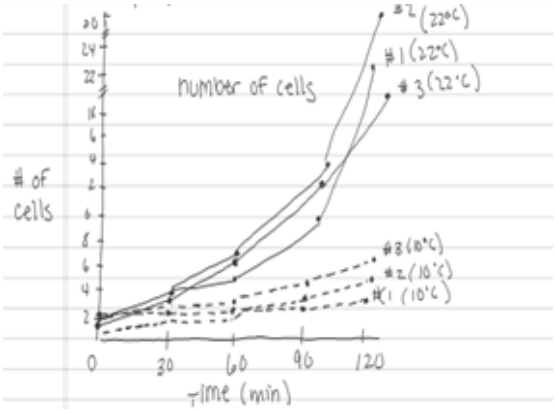
Participant Code	Scenario	Doctoral Research Emphasis	Year in Graduate School	Undergraduate Research Experience?
GS 1	Bacteria	Microbiology	3rd	UG, screened to identify virulence factors of *Mycobacterium marinum*
GS 2	Plant	Cancer Biology and Immunology	4th	UG, population surveys of freshwater mussels
GS 3	Plant	Plant and Soil Ecology	2nd	UG, characterized magnetotactic bacteria
GS 4	Bacteria	Avian Behavior	2nd	UG, education research, studied task switching
GS 5	Bacteria	Structural Biology	4th	UG, compared phenotypes of wild type and mutant bacteria
GS 6	Bacteria	Virology and Gene Therapy	4th	UG, clinical trials
GS 7	Bacteria	Infectious Diseases	5th	UG, expression, purification and crystallization of a recombinant protein that is involved in the degradation of a specific class of xenobiotics
GS 8	Plant	Retinal Degeneration and Drug Development	2nd	UG, sequenced data from human patients

Supplemental Materials, Table 4. Demographic information for professor participants

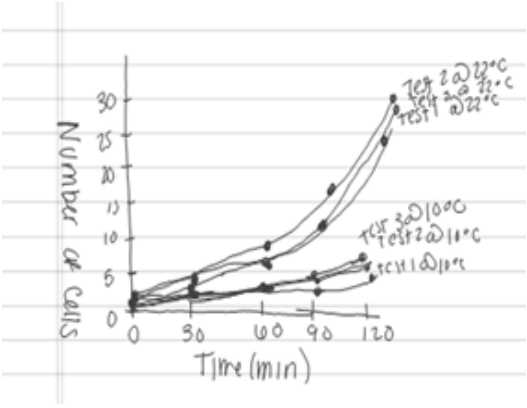
Participant Code	Scenario	Field of Research	Teach Graphing in the Classroom?
P 1	Bacteria	Behavioral neuroscience	All aspects of experimental design and statistical analysis to assist with making relevant choices of numbers of subjects, control groups and inferential statistics appropriate for hypothesis testing.
P 2	Bacteria	Behavioral ecology	Elements of experimental design.
P 3	Bacteria	Microbial genetics & physiology	Enzyme assays with standard deviations and measures of significance.
P 4	Plant	Cellular neurobiology	Discuss experimental data form classic experiments in graphic form for enzyme kinetics and membrane potential chapters. Graphs are used to solve problems.
P 5	Plant	Neurobiology	Discuss graphs and experimental techniques used in neurobiology.

Supplemental Materials, Figure 1. Graphs constructed from the bacteria scenario for undergraduates with no research experience (UGNR)

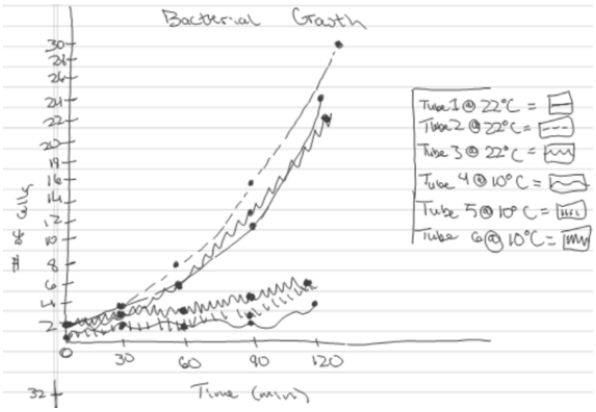
UGNR4_1st year



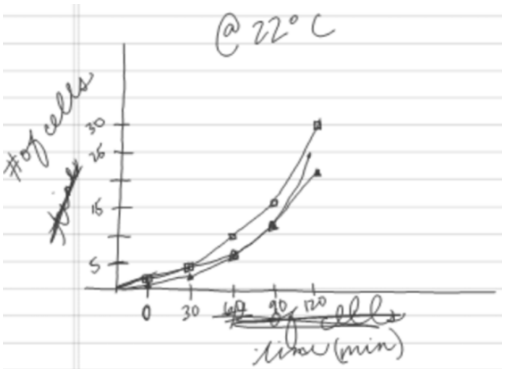
UGNR1_2nd year



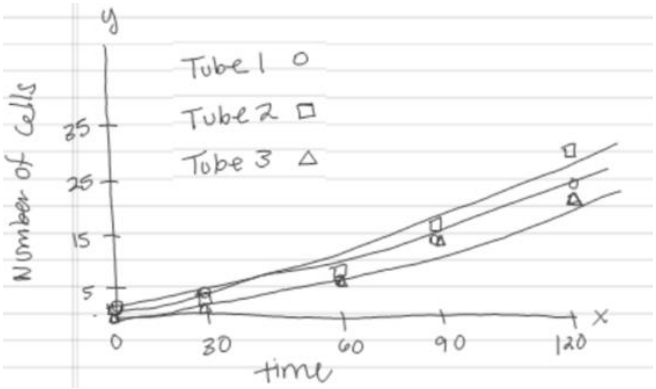
UGNR9_2nd year



UGNR8_1st year

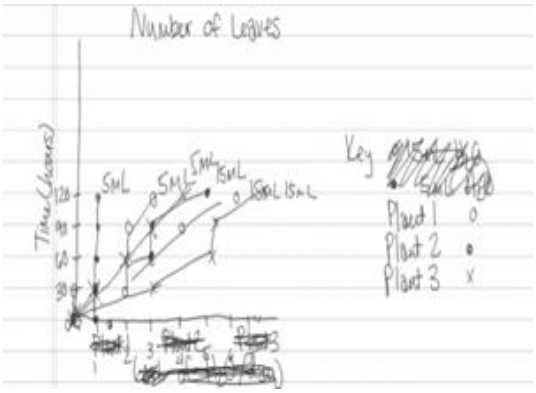


UGNR7_3rd year

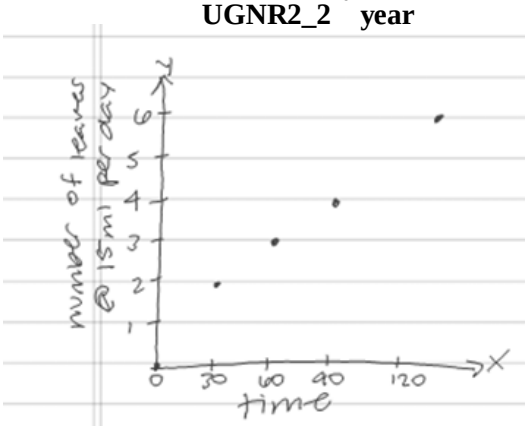


Supplemental Materials, Figure 2. Graphs constructed from the plant scenario for undergraduates with no research experience (UGNR)

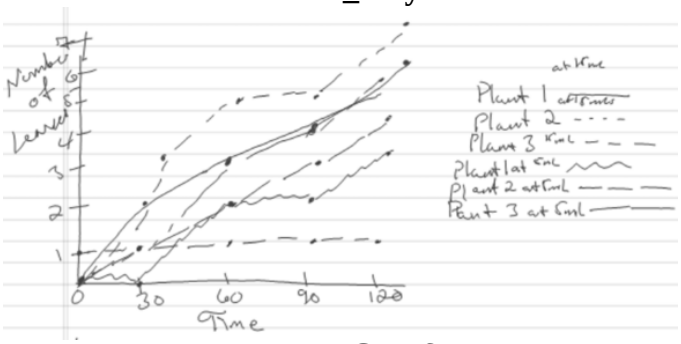
UGNR3_1st year



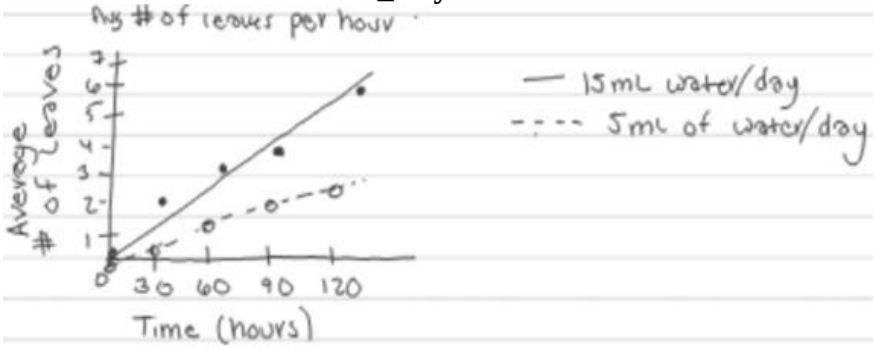
UGNR2_2nd year



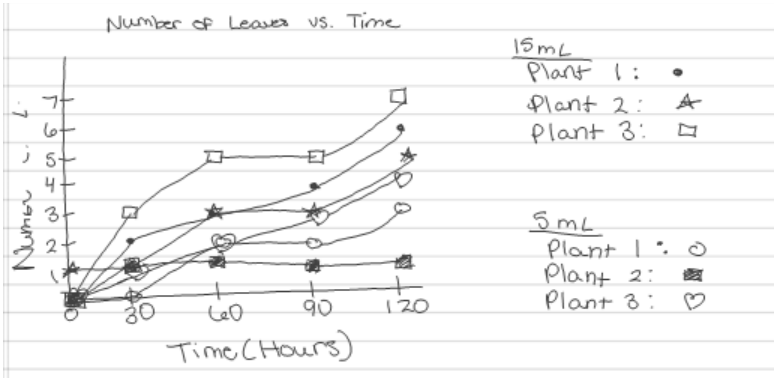
UGNR10_3rd year



UGNR6_1st year

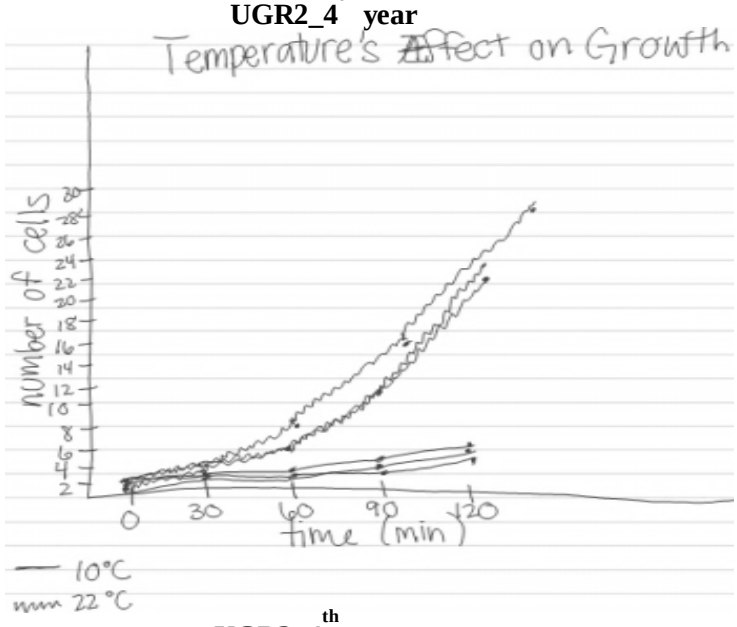


UGNR5_1st year

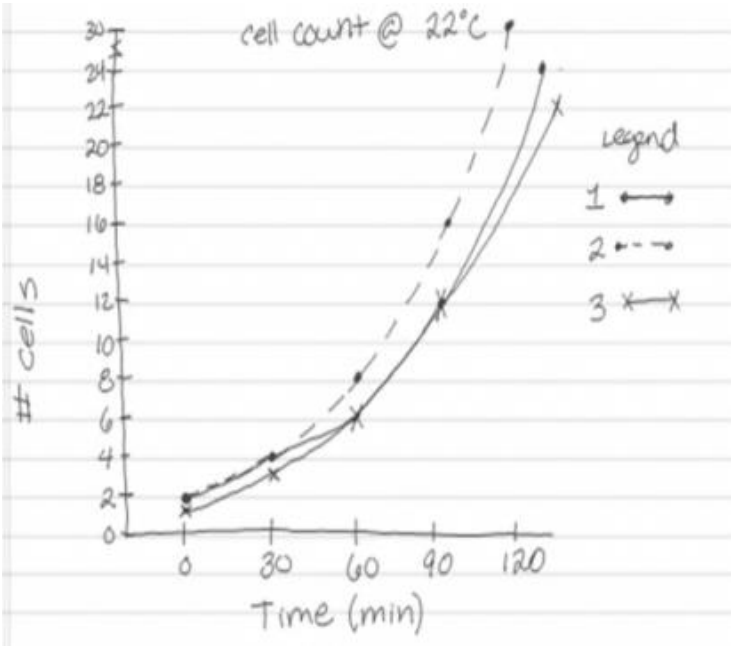


Supplemental Materials, Figure 3. Graphs constructed from the bacteria scenario by undergraduates with research experience (UGR)

UGR2_4th year

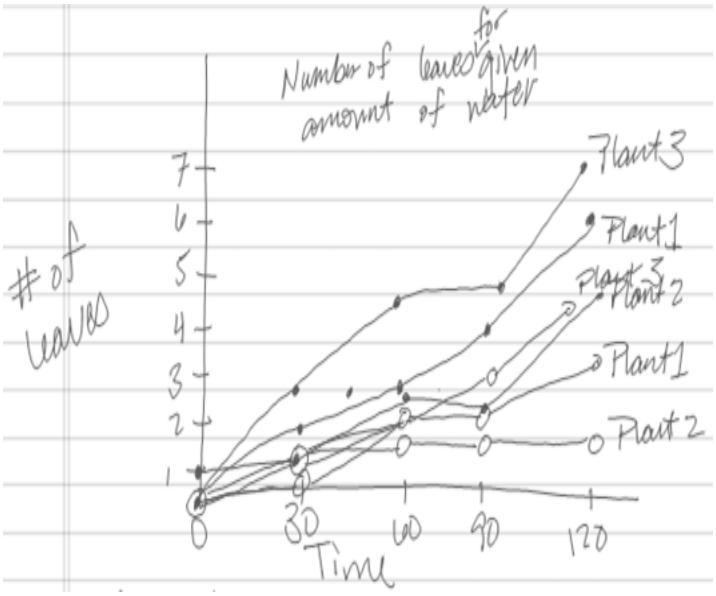


UGR3_4th year

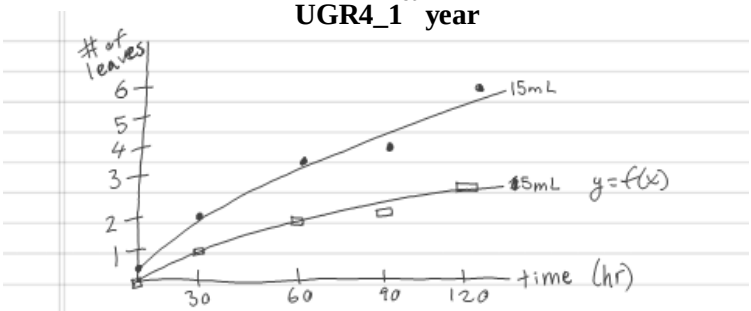


Supplemental Materials, Figure 4. Graphs constructed from the plant scenario by undergraduates with research experience (UGR)

UGR1_4th year



UGR4_1st year

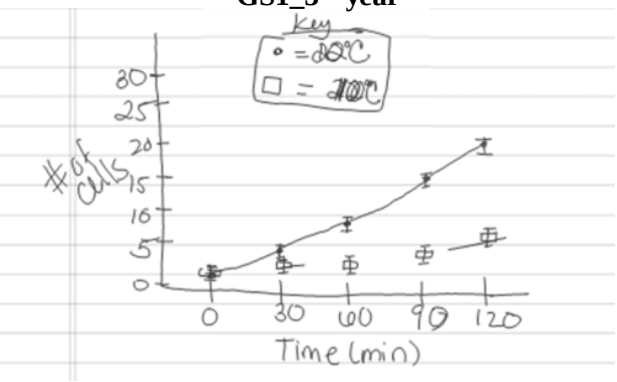


	15 mL H_2O/day •	5 mL H_2O/day □
0	0.33	0
30	2	0.66
60	3.66	1.66
90	4	2
120	6	2.66

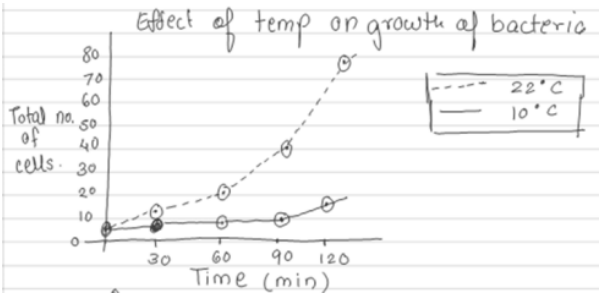
UGR5_4th year

Supplemental Materials, Figure 5. Graphs constructed from the bacteria scenario by graduate students (GS)

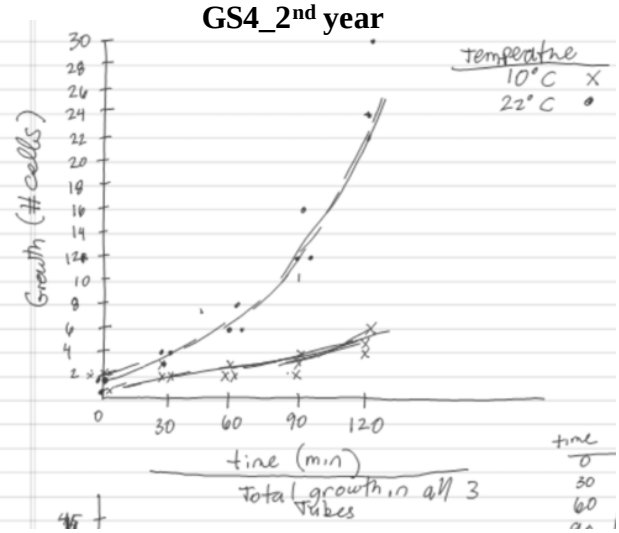
GS1_3rd year



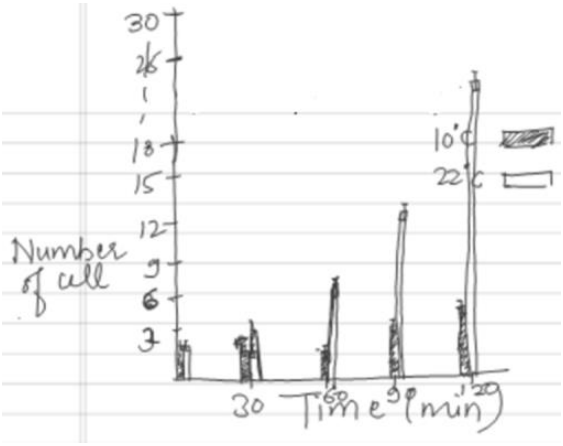
GS6_4th year



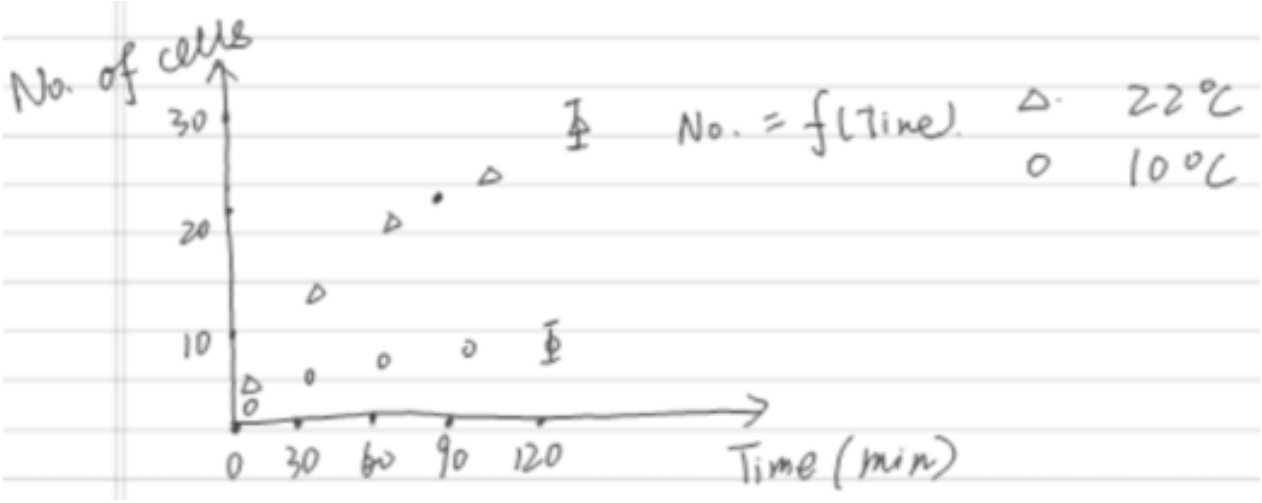
GS4_2nd year



GS7_5th year

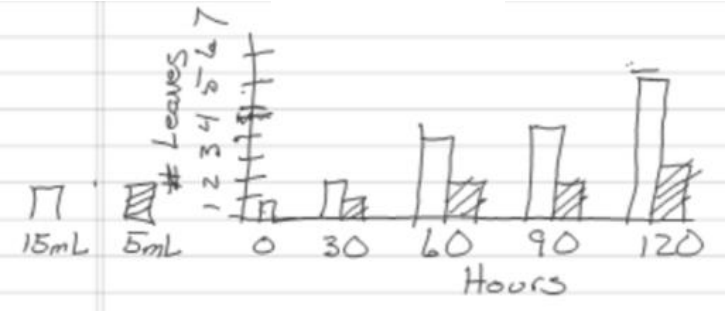


GS5_4th year

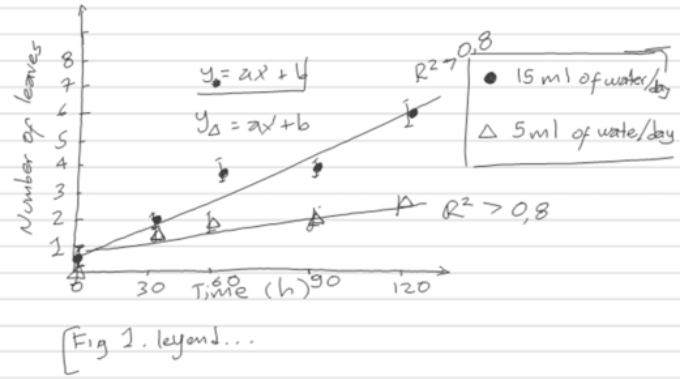


Supplemental Materials, Figure 6. Graphs constructed from the plant scenario by graduate students (GS)

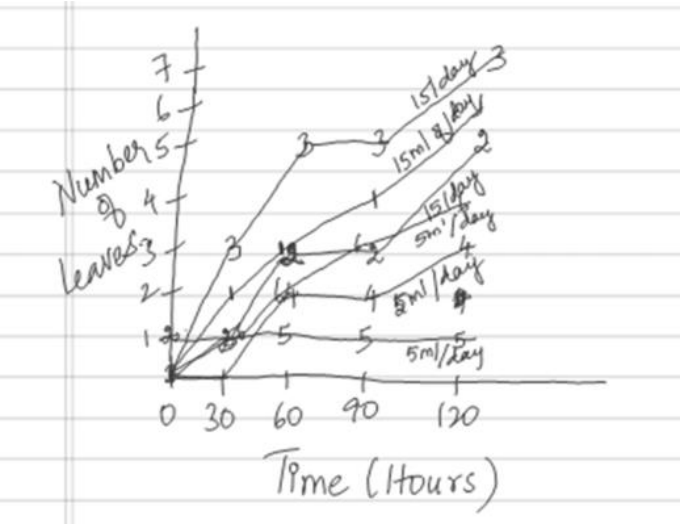
GS2_4th year



GS3_2nd year

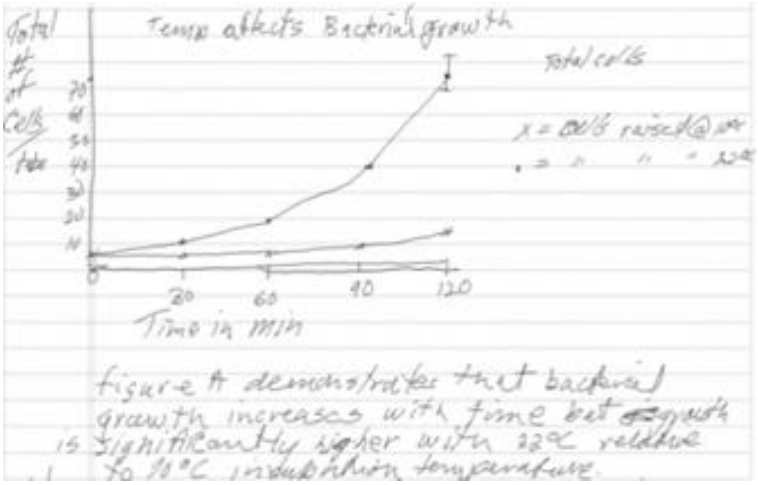


GS8_2nd year

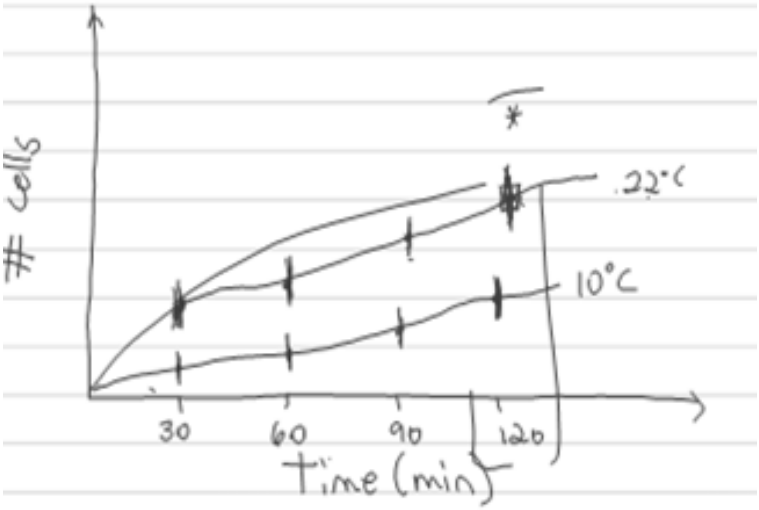


Supplemental Materials, Figure 7. Graphs constructed from the bacteria scenario by professors (P)

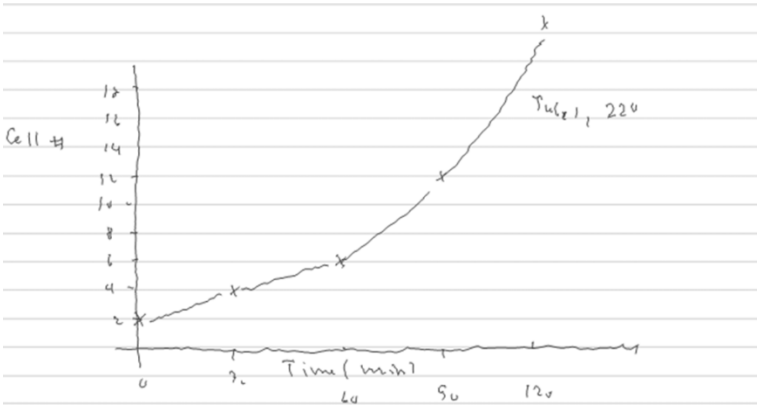
PI_ Behavioral Neuroscience



P2_ Behavioral Ecology

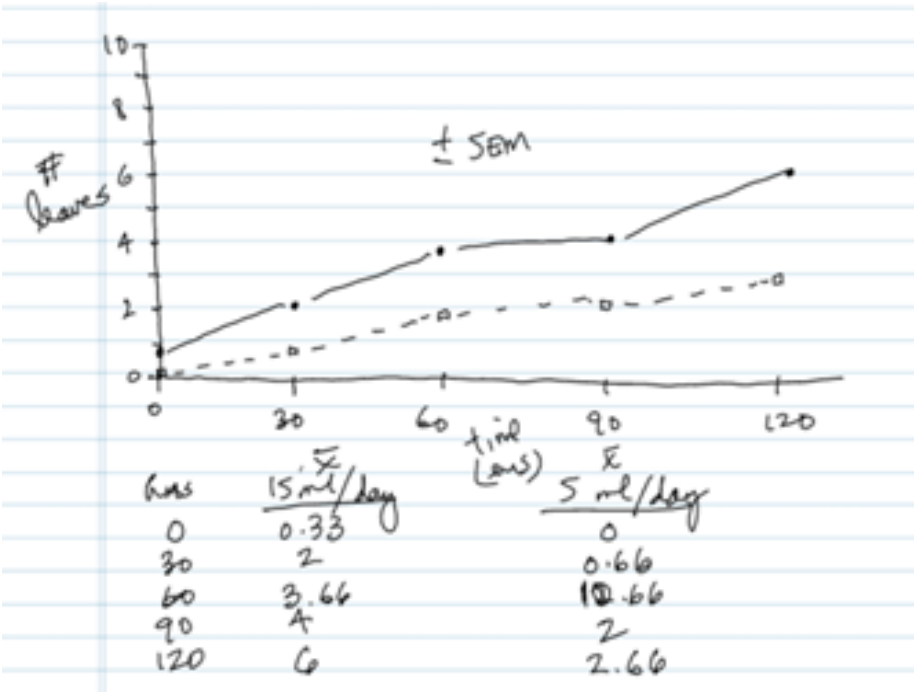


P3_ Microbiology



Supplemental Materials, Figure 8. Graphs constructed from the plant scenario by professors (P)

P4_Cellular neurobiology



P5_Neurobiology