Biology 113 Closed Book Take-Home Exam #2 – Chapters 4 - 6

There is no time limit on this test, though I have tried to design one that you should be able to complete within 3 hours. There are 6 pages in the exam, including this cover sheet and the data gallery. You are not allowed to look at someone else's test, nor use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone until all exams are turned in no later than 12:30 pm on Monday October 21. **EXAMS ARE DUE BY 12:30 pm ON MONDAY OCTOBER 21**. If you turn in your exam late, you will lose a letter grade for each day you are late. The **answers to the questions must be typed within this test** unless you want to draw on a separate page. If you do not write your answers in the appropriate location, I may not find them. Tell me where to look if you put your answer at the back of your test.

I have provided you with a "Data Gallery" in the form of figures and tables. To choose a figure in support of your answer, simply state Figure #x. You do NOT need to move the figure on your test. Do not assume how many of the data images you will use, or not use. **Simply choosing the data is not sufficient support for your answer. You must explain the significance of the data and how they support your answer.** I have given you sentence limits so be concise.

AVG = 84.2 Added 5 pts. Range 100 – 61.

-3 pts if you do not follow this direction.
Please do not write or type your name on any page other than this cover page.
Staple all your pages (INCLUDING THE TEST PAGES) together when finished with the exam.

Name (please print):

Read the pledge and sign if you can do so with honor:

_____

On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

Lab Questions:

4 pts.

1) Last year, I had a student whose name was Kureaids Furbeeplus Campbell (no relation), but we will refer to the student as KFC. KFC cloned two different promoters and tested their effectiveness relative to a positive control as shown in the table below. Sadly, KFC misinterpreted the data. Please help out KFC by interpreting the data correctly.

promoter	level	stdev	p value vs pos control
experimental_1	56743	8765	0.16
experimental_A	123987	5781	0.03
neg_control	2540	487	0.0002
pos_control	87548	12673	

Exp. 1 is no different than positive control (p = 0.16) but that means the promoter worked.
Exp. A is significantly stronger than positive control (p = 0.03).
Negative control is significantly lower than positive control (p=0.0002).

9 pts.

2) You **may NOT USE the Guided Tour**. You must answer this question using your own experience of analyzing DNA sequences. I emailed you a zipped file that contains four known TAS2R38 sequences and information about Pat's DNA (1 DNA sequence and 1 chromatogram). I want you to use ApE to:

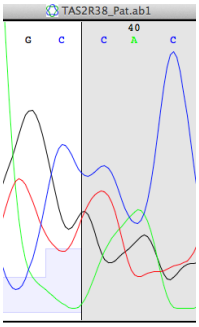
a) tell me the SNP genotype for Pat

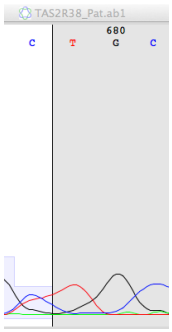
b) tell me if Pat is homozygous or heterozygous for each SNP. You must supply screen shots to support your data for part b only.

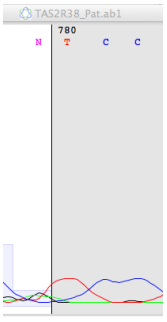
SNP #	Genotype	homozygous or heterozygous
1	C	homozygous
2	C/T	heterozygous
3	N (G/A)	heterozygous

Supporting data copy and pasted here, or at the end of the test. Tell me where to look.
SNP is immediately to the left of the gray area.

#1 homozygous #2 heterozygous #3 heterozygous







Lecture Questions:

8 pts.

3) How do male and female fire flies of the same species respond to changes in temperature during mating season? Support your answer with data. **Limit your answer to a maximum of 3 sentences.**

males (figure 6)
increase temp = shorter IPI
decreased temp = longer IPI
females (figure 33)
preferred IPI changes with temperature so that when the females are colder, they prefer longer IPI. See 1.6 seconds as example.

9 pts.

4) What is the function of each of the storm petrel calls listed below? Provide supporting evidence for each of your answers. **Limit your answer to a maximum of 2 sentences for each call.**

a) grating call 1 #10: face-to-face, probably male-male, not significant but a trend
b) grating call 2 #10 face-to-face, male-female, significant difference
c) chattering call 1&2 #17 circling behavior is the only one that looks significant, no stats though (no gender or set meaning other than circling)

8 pts.

5) What derived trait do meerkats exhibit that provides them with a selective advantage? Support your answer with data that *includes statistical analysis*. **Limit your answer to a maximum of 3 sentences.**

vocalizations and division of labor (sentinels)
figure #20:
significantly less time on alert when vocalizations heard (10%) vs. background noise (20%)
this is adaptive behavior

8 pts.

6)

a) What two common messages do mole crickets convey with their sound? Support your answer with data. **Limit your answer to a maximum of 2 sentences.**

same gender, opposite sex (male calling to female): figure # 14

b) Describe the cricket information intercepted by the parasitic tachinid fly. Support your answer with data. **Limit your answer to a maximum of 2 sentences.**

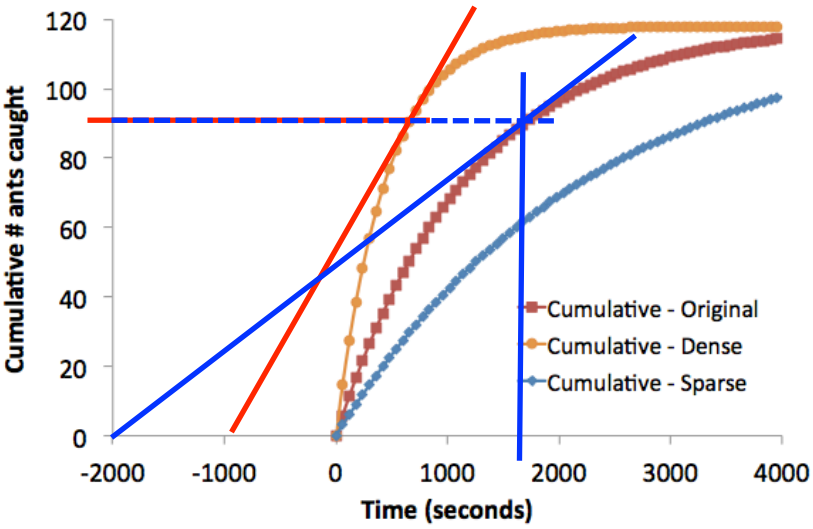
recognize 3 of 5 species as potential food for offspring: figure #4

9 pts.

7) I have provided you with a average consumption graph of three different lizard feeding habitats. Based on these data, I want you to answer two questions and support your answer by modifying the graph as needed. I should be able to look at your modified graph and see how you reached your answers.

a) Approximate the cumulative number of captured ants when the optimal foraging lizard leaves the typical "Dense" nest if the travel time between nests was 1000 seconds.
answer:__~95___ ants

b) How long would the optimal foraging lizard stay at a typical "Original" nest if the travel time between nests was 2000 seconds?
answer:__~1800__ seconds



c) What would the average capture RATE be at departure for the lizard in question "b", including travel time?
answer:__95/3800 = 0.025 ants per second

10 pts.

8) Most people do not realize the many different ways plants use information when foraging for food. Luckily, you are not most people. Give me two examples of plants using information to affect their foraging for nutrients. You must support each example with experimental data. **Limit your answer to a maximum of 2 sentences for each of your two examples.**

1. #19 left: bigger roots with lower quality soil
2. #19 right: some species grow more roots to the right (rich) side compared to the control (sand) side. species 3-7 with increasing bias as number gets higher.

17 pts.

9)

a) Define evolution.

b) List the five tenets of natural selection and provide an example of each one using the origins of the first living cell. **Limit your answer to a maximum of 2 sentences for each number.**

1. overproduction: many vesicles formed abiotically
2. variation: ribozyme genomes or vesicles with different cargo
3. competition for limited resources: ribozyme speed or vesicles stealing lipids from each other

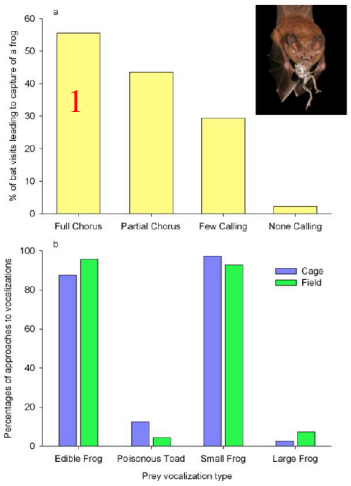
4. selective advantage: faster ribozyme polymerization rates or stressed vesicles winning over less stressed vesicles
5. reproduction: vesicle growth, division and spilling contents

8 pts.
10) Typically, introductory biology courses minimize the role of mathematics in understanding biology. Most national biology organizations have recommended the inclusion of more math in biology courses (*e.g.* AP Biology redesign, Vision and Change, BIO2010, MCAT testing and many others). Bio113 and 114 are trying to follow national guidelines. Use a mathematical argument with specific numbers from the data gallery that demonstrate how the earliest, primitive cells could have distributed their most successful genomes to new primitive cells. Support your answer with data. **Limit your answer to a maximum of 3 sentences.**
#24 90% surface area → 262% volume → loss of content when vesicles divide.
faster ribozyme polymerases generate more osmotic pressure and spread successful genomes

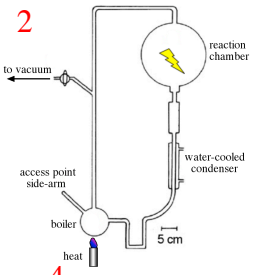
10 pts.
11)
a) How did eukaryotes come into existence? Support your answer with data. **Limit your answer to a maximum of 3 sentences.**
#11: fusion of two genomes (archaea and eubacteria)
b) What traditional way of thinking about evolution has led to an incorrect interpretation of the data related to the origin of eukaryotes? Support your answer with data. **Limit your answer to a maximum of 2 sentences.**
#32 linear branches of slow change, evolutionary tree based on one gene

Data Gallery

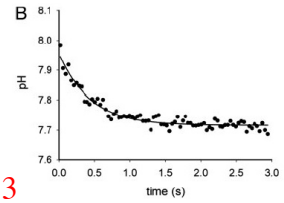
1



2



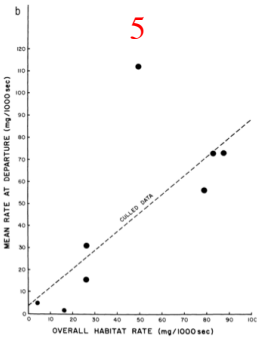
3



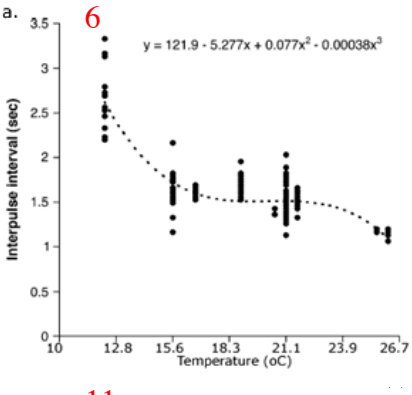
4

mole cricket call	number of tachinid flies
southern	24
tawny	51
imitator	33
changa	0
northern	0

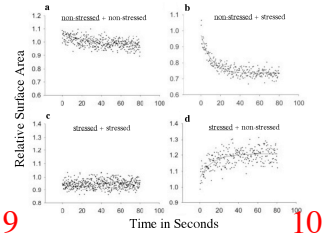
5



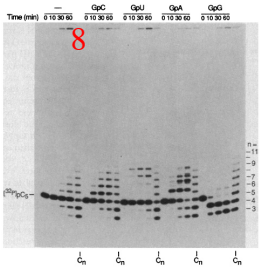
6



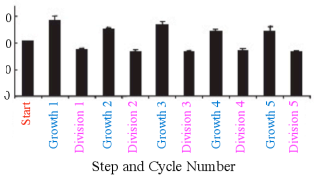
7



8



9



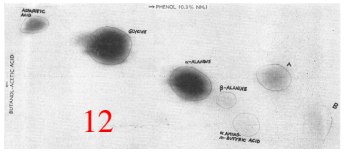
10

(a)			
	call uttered		
situation of the bird	Chattering	Chattering and grating	Grating
bird alone (n = 96)	38	35	23
flown over by another bird (n = 69)	33	18	18
facing another bird (n = 95)	9	16	70
(b)			
compared situations	χ^2	p-value	
alone *vs.* flown over	2.05	0.36	
flown over *vs.* facing another	41.5	1 x 10^{-9}	
alone *vs.* facing another	48.7	2 x 10^{-11}	

11

Human Protein #	Protein Function	Protein Location	Best Match Domain
NP_001009	Translation	Cytoplasm/ ER	Archaea
NP_003185.1	Transcription Factor	Nucleus	Archaea
NP_001001937	ATP synthase	Mitochondria	Bacteria
NP_005521	Energy Harvesting	Mitochondria	Bacteria
NP_000393	Energy Harvesting	Cytoplasm	Bacteria
NP_004138	Cell Signaling	Cytoplasm	Archaea
NP_061816	Cytoskeleton	Cytoplasm	Bacteria

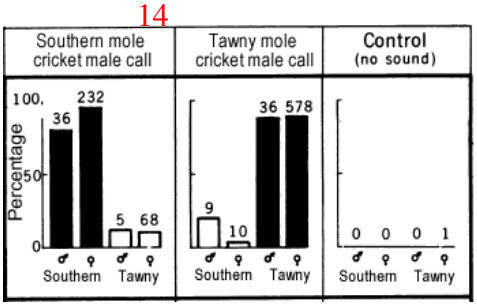
12



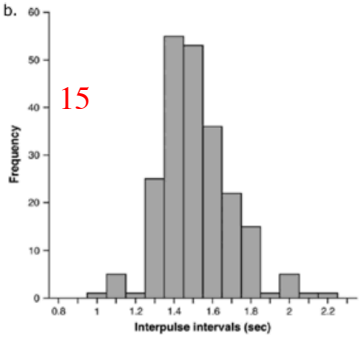
13

	male-male interactions (n = 45)			
	grating call 1	grating call 2	χ^2	p-value
frequency	29	16	3.76	0.053
percentage	64%	36%		
	male-female interactions (n = 37)			
	grating call 1	grating call 2	χ^2	p-value
frequency	4	33	26.57	2.5 x 10^{-7}
percentage	11%	89%		

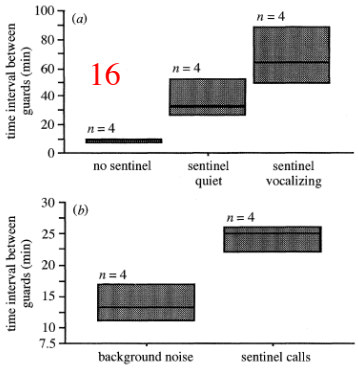
14



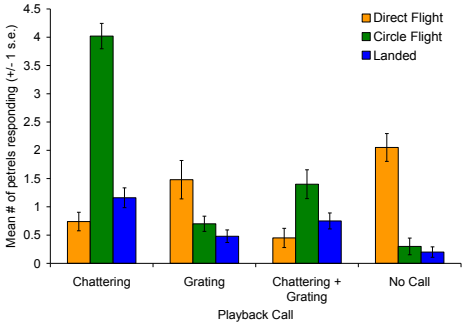
15



16



17

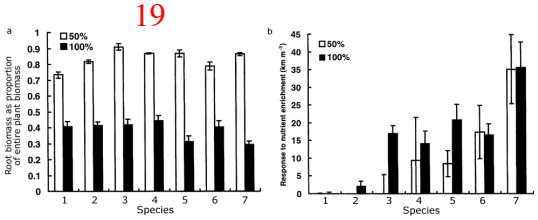


18

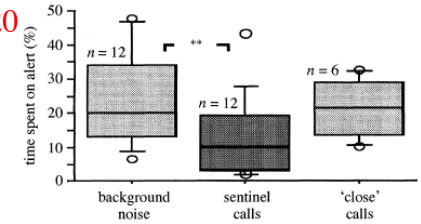
	Ovule with associated pollen tube after 20 hours	Ovule without associated pollen tube after 20 hours
Normal ovule	124	60
Abnormal ovule	0	189

Dr. Campbell's Bio113 Exam #2 – Fall 2013

19



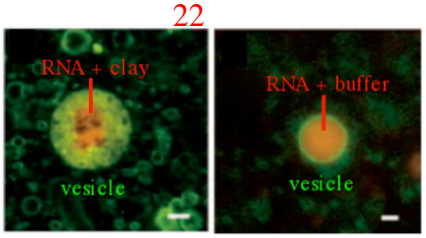
20



21

Treatment	*Hypothesized to be present in medium when cells are added to culture* Strain 1 signal	Strain 2 signal	*Optical density at point of luminescence after inoculation with …* Strain 1	Strain 2
Control	No	No	0.3-0.4	0.1-0.15
Strain 1 fluid	Yes	No	Immediate	0.03-0.05
Strain 1 fluid, filtered twice	Yes	No	Immediate	
Strain 1 fluid, boiled	Yes	No	0.03-0.05	
Strain 2 fluid	No	Yes	0.03-0.06	Immediate
Strain 2 fluid, filtered twice	No	Yes		Immediate
Strain 2 fluid, boiled	No	Yes		Immediate

22



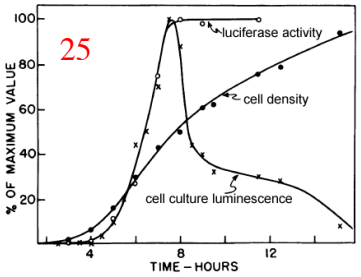
23

Treatment	mean number of trials	standard error	sample size
inexperienced bat with experienced bat	5.3	1.7	10
two inexperienced bats	96.8	3.2	5
one inexperienced bat	96.2	3.8	5

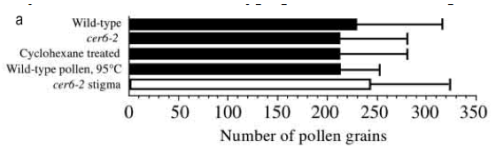
24

Vesicle Type	Radius (nm)	Surface Area (nm²)	Volume (nm³)
Small vesicle	45	25,400	381,500
Large vesicle	62	48,300	997,800
Percent Change	+38%	+90%	+262%

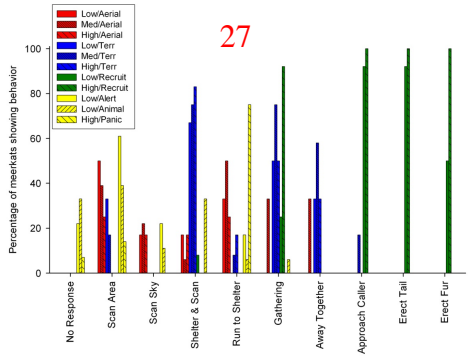
25



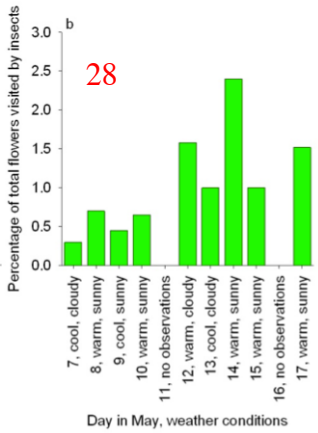
26



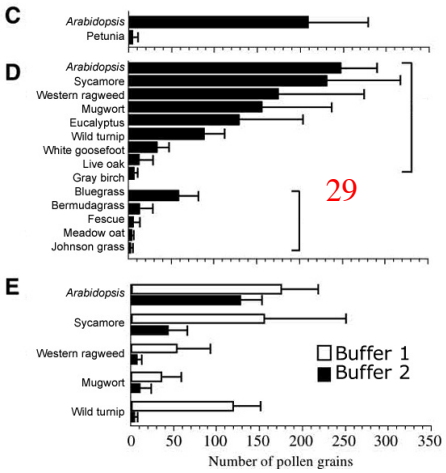
27



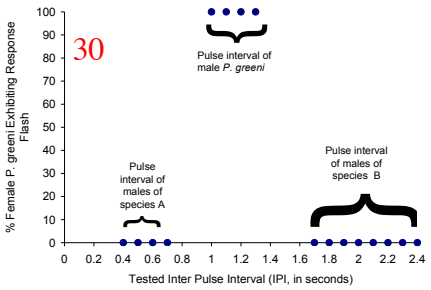
28



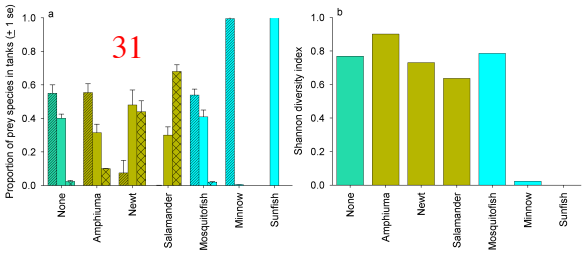
29



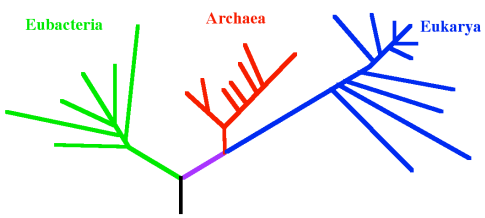
30



31



32



33