Bio 112 Handout for Ecology 1

This handout contains:
- Today's iClicker Questions
- Handouts for today's lecture
- Information for Exam 3

iClicker Question #29A - <u>before</u> lecture

Which of the following are true?

A. The annual pattern of high and low rainfall is the same all over the world.
B. Plants only require warm temperatures to grow.
C. The temperature varies less over the course of a year in the tropics than elsewhere on earth.
D. All of the above
E. None of the above

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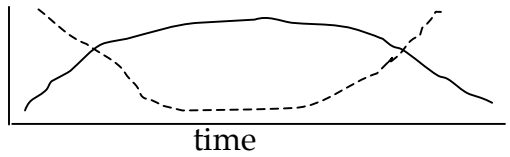
iClicker Question #29B - <u>after</u> lecture

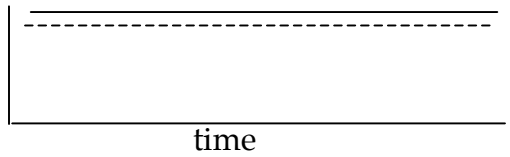
Which of the following climates would have the longest growing season?

Temperature ——— Rainfall - - - - - - - - - - -

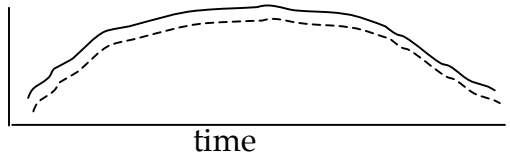
A)



B)



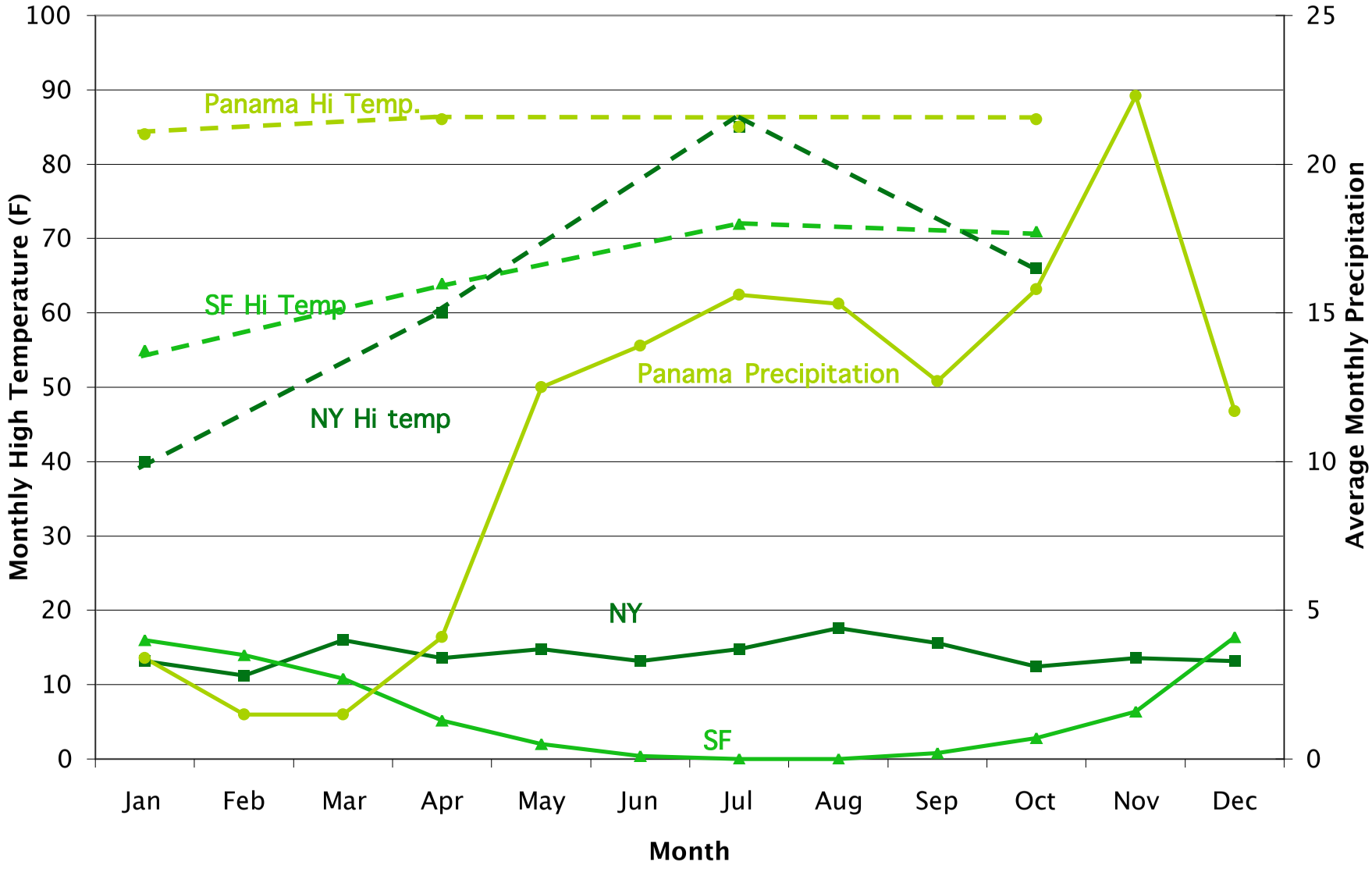
C)

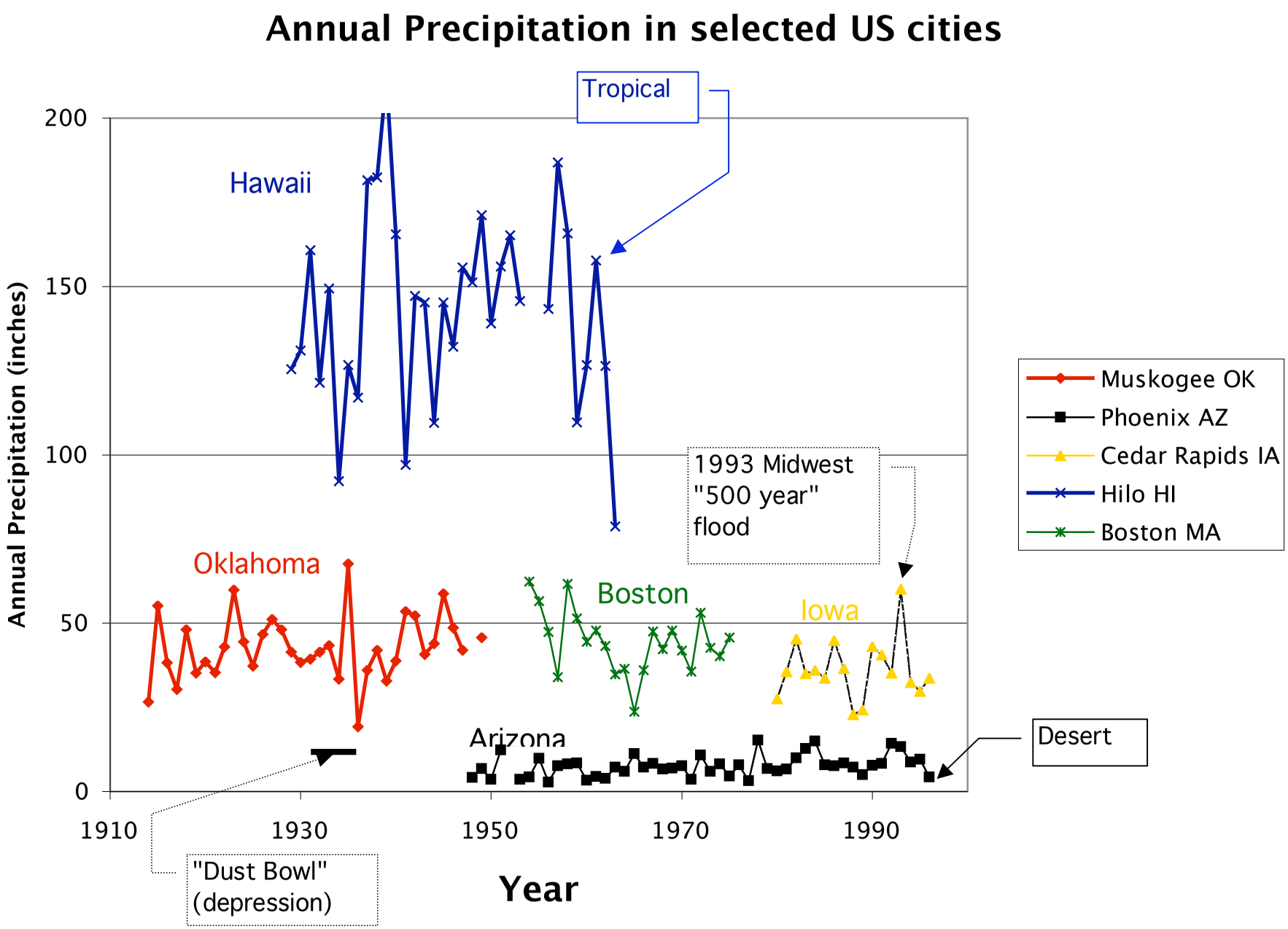


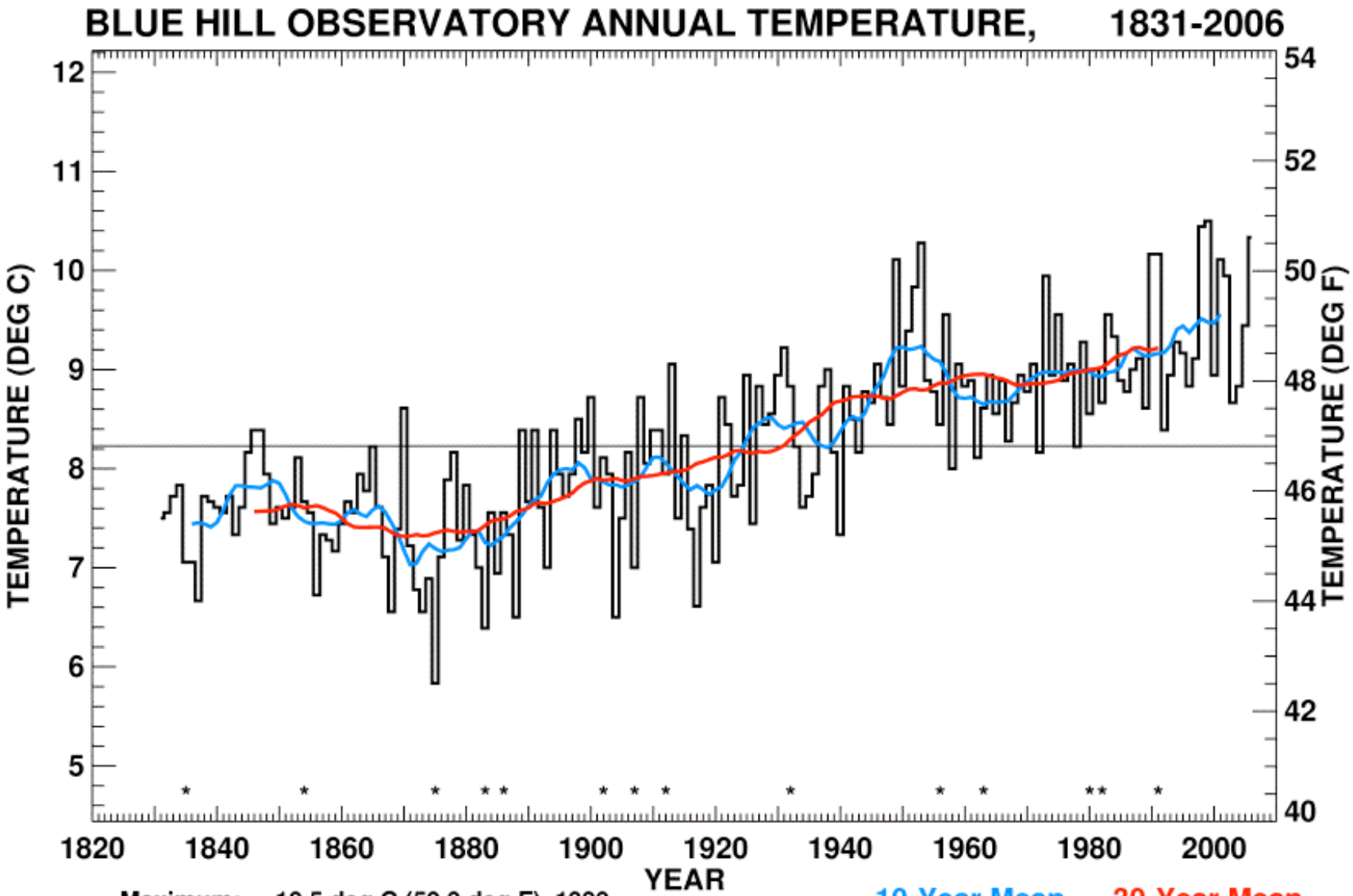
D) All would have the same length growing season.

Figure out your answer and select the appropriate number (A-E) then send in your answer.

Precipitation & Temperature







Maximum: 10.5 deg C (50.9 deg F), 1999
Minimum: 5.8 deg C (42.5 deg F), 1875
Record Mean: 8.2 deg C (46.8 deg F)

* Indicates dates of largest global volcanic eruptions.

Note: Plot includes temperature data for 1831-1884 from Milton and Canton that were adjusted to the Blue Hill summit location.

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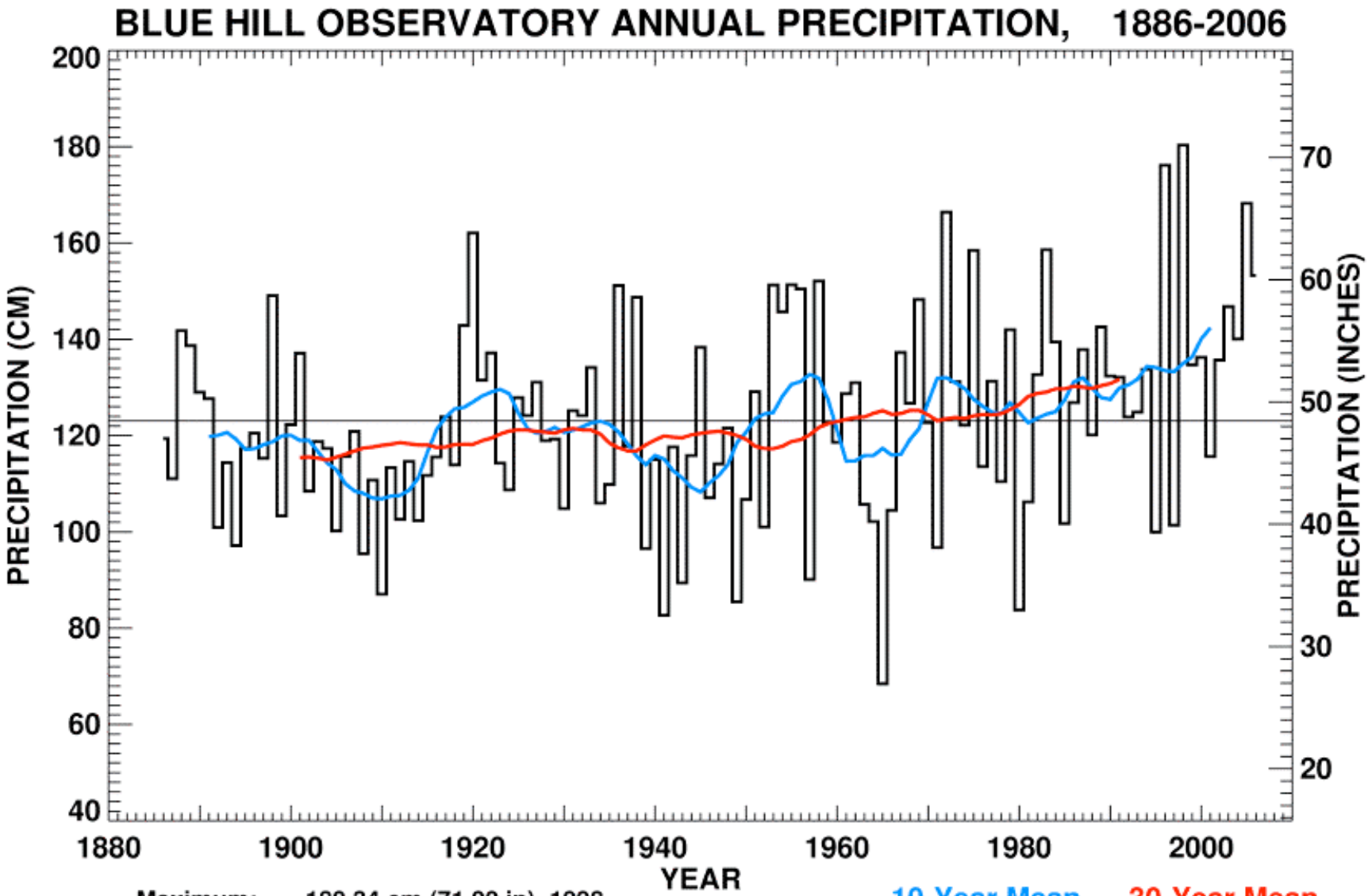

Maximum: 180.34 cm (71.00 in), 1998
Minimum: 68.48 cm (26.96 in), 1965
Record Mean: 123.09 cm (48.46 in)

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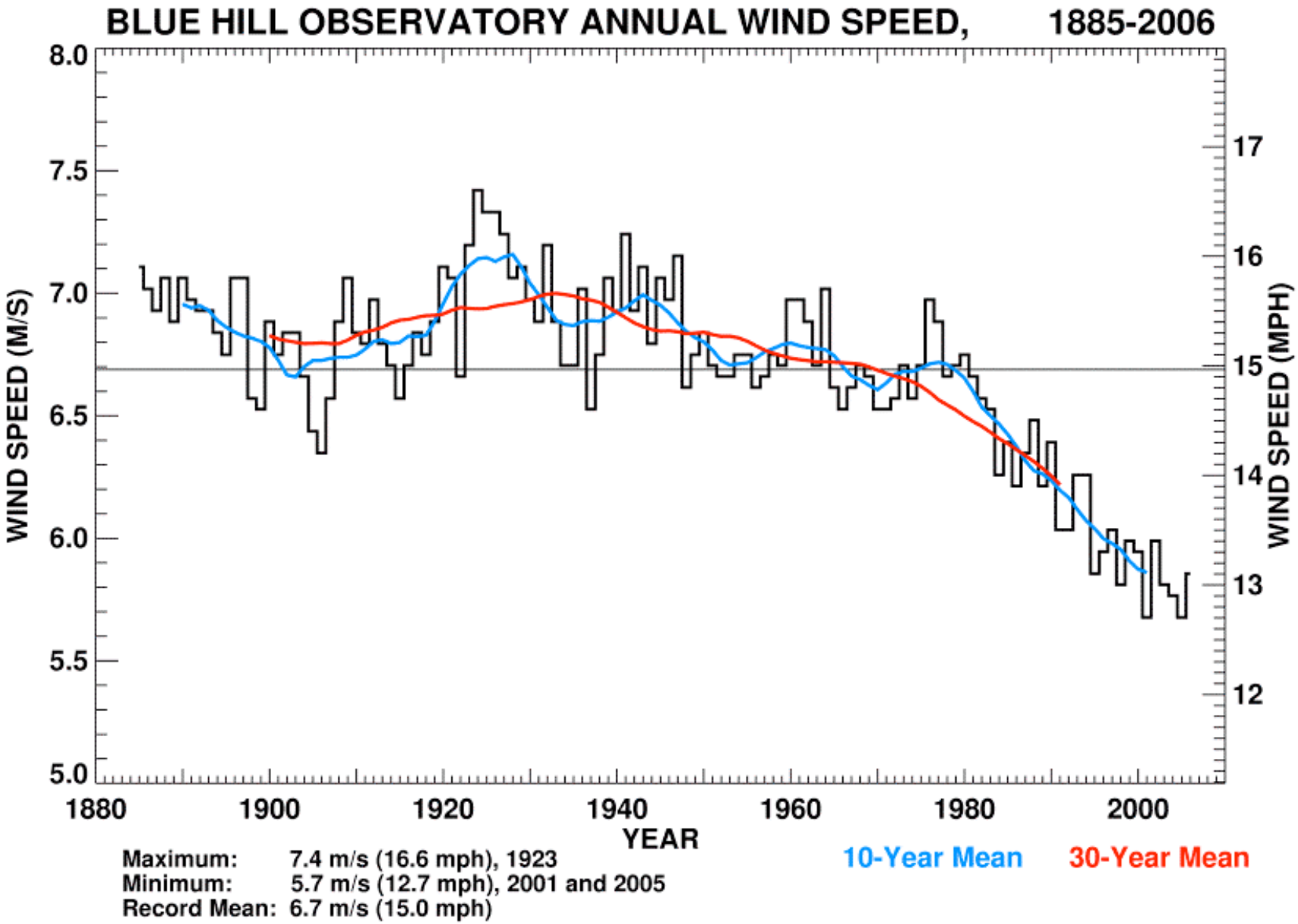

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Bio 112: Information for Exam III

Basic Facts

- The exam will be held in rooms TBA as listed in the syllabus from 12:00 to 12:50.
- The exam will cover reading, lab, and lecture from Animals 1 through Physiology 8 as described below.
- The exam will consist of approximately 4 questions. These will not be multiple choice; they will be problem-solving or short answer. In general, the questions will expect you to apply and make connections between the things I have talked about in lecture. [Numbers in brackets refer to particular lectures]

– You need to know:

- what the systems in the "schematic animal" [Animals #1] do and in which of these systems the organs I mentioned in lectures function.
- the 15 different properties of the 10 different groups of animals as specified on the "Animal Lecture Outline" handout. You need to know only the level of detail I presented in lecture. For the information I told you to know but did not cover in lecture, you should know it at a level of detail that is comparable with the details I presented in lecture.
- how to explain the different adaptations of the physiological systems in terms of size, scale, habitat, etc.
- how the movement of ions across a membrane can affect the membrane potential
- the different ion channels, pumps, receptors, and enzymes I mentioned in lecture (Na^+/K^+ ATPase pump, K^+ channel, voltage-gated Na^+ channel, NT-gated Na^+ or K^+ channel, Acetyl-choline receptor, Acetyl-choline receptor, Ca^{++} pump in the SR, actin, myosin, ATP, Ca^{++} ions, ORP, G-protein, ATCase, cAMP, cAMP-gated Na^+-channel), their effects on membrane potential (as appropriate), how their opening & closing are controlled (where appropriate), and their roles in the processes listed next.
- The mechanisms of (at the level of detail I gave in lecture):
  - action potential
  - synaptic transmission
  - muscle contraction
  - stimulatory & inhibitory effects on neurons
  - resting potential
  - sensation of smell in the OSN cells
  - sensation of light in rod cells (this was not covered in lecture; you do need to know it at the same level of detail as smell sensation - see fig 50.21).
- the material on excretion given in lecture [Physiology #7 & #8]

– You **do not** need to know:

- the details of nasal anatomy, brain anatomy, or chemistry from the "smells" lecture
- the specific functions of any neurotoxins or drugs

• The exam will consist of questions like (also see exam from last year at end of lab manual; solutions are attached):

– "what are the 2 major differences between the nervous systems of... explain how these differences reflect the organism's lifestyle, habitat, etc.."
– "there are 2 types of excretory systems, A and B, give an animal with each type"
– "which ions are moving, in what directions, & thru what channels during the action potential (or inhibitory synapse, stimulatory synapse, etc.)
– "what would be the effect on the muscles/sensations of an animal treated with neurotoxin X, which blocks the Y channel?"
– "if I open the Z channel, which way will the Z ions flow & what effect will this have on the membrane potential/firing of an action potential"

NOTE: When noting differences, you must include both parts of the comparison. For example, if the question asked "Give one difference between a dog and a cat.", and you answered "Dogs bark" or "Cats meow", you would get very little credit. The full-credit answer is "Dogs bark and cats meow". Also, simply restating the question ("One is a dog and the other a cat") is not worth any credit.

• You may bring in a single sheet of (8 1/2 x 11 inch) paper with any notes you want. You may write on both sides.

Bio 112 Exam #3

4/28/08

Your Name:_____

PLEASE CIRCLE YOUR LAB SECTION:

(1) Tues AM Aimee	(4) Weds AM Juan	(7) Thurs AM Alex
(2) Tues AM Tsering	(5) Weds PM Alex	(8) Thurs PM Martine
(3) Tues PM Martine	(6) Weds PM Juan	(9) Tues PM Tsering
		(11) Thurs PM Aimee

Write your initials on every page in the space provided.
This exam has 7 pages including this coversheet.
Check that you have pages 1-7.

This exam has four questions.

Make your answers as clear and precise as possible.
Answer all questions in the space provided.

Question	Value	Score
1	34	_____
2	20	_____
3	34	_____
4	12	_____
Bonus	1	_____
TOTAL:	101	_____

Question 1: Animal Diversity (34 points)

a) Consider the **respiratory** systems of a **nematode** and a **caterpillar**:

i) What is the major difference between the **respiratory systems** of the two? (3 pts)

ii) Draw a rough sketch of each organism's respiratory system that shows this difference. Your sketch should only show enough detail to make this difference clear; label the directions of O_2 and CO_2 flow as appropriate. (8 pts)

nematode **caterpillar**

b) Give **two** differences between the **nervous systems** of a **nemertean worm** and a **jellyfish**.

i) (2 pts)

ii) (3 pts)

Question 1, continued:

c) Give **three** differences between a roundworm (**nematode**) and a flatworm (**planarian**).

i) (2 pts)

ii) (3 pts)

iii) (4 pts)

d) Give **three** differences between a **squid** and a **sponge**.

i) (2 pts)

ii) (3 pts)

iii) (4 pts)

Question 2: Animal Diversity II (20 points)

Use the following animals to answer the questions on this page.

- sponge
- jellyfish
- planarian
- nematode
- squid
- caterpillar
- earthworm
- starfish
- trout
- nemertean worm

a) Give two animals from the list above that are capable of **regenerating** significant parts of themselves.

(2 pts)

(3 pts)

b) There are at least three different types of **digestive systems** we have looked at. For each, give **one** animal from the list above that has that type of digestive system. If more than one is possible, give only one. (3 pts each)

No digestive system _____

Gastrovascular cavity _____

Flow-through digestive system _____

c) Many of the animals we have discussed have one or more **hearts**. For each number of hearts, give one animal from the list above that has that number of hearts. If more than one is possible, give only one. (2 pts each)

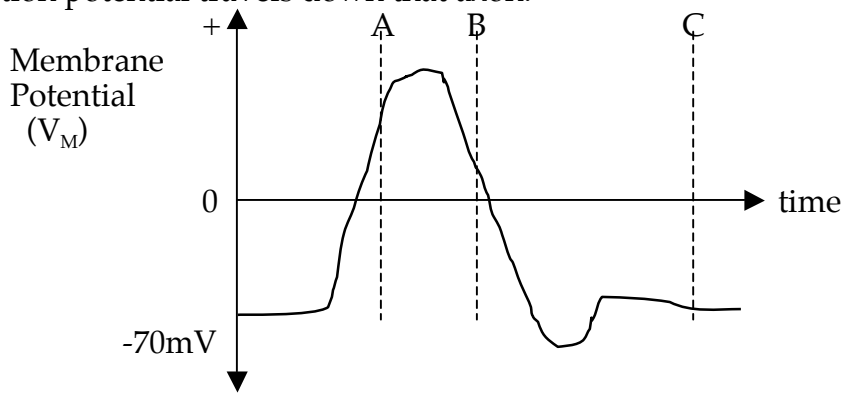
No heart _____

Only one heart _____

More than one heart _____

Question 3: Neurobiology (34 points)

a) Shown below is a plot of membrane potential at a single point on an axon as a function of time as an action potential travels down that axon:



For each of the three time points indicated, fill in the boxes in the following table with the appropriate term; choose from the terms in {braces} in the left column of the table. Please use the terms provided. (2 pts each)

Time Point	**A**	**B**	**C**
K^+ Flow through K^+ Channel {Into axon, Zero, Out of axon}			
Na^+ Channel status {Inactivated, Closed, Open}			
Na^+ Flow through Na^+ Channel {Into axon, Zero, Out of axon}			

b) Botulinum toxin is a neurotoxin produced by a bacterium; it is the active ingredient in the cosmetic Botox. Botulinum toxin prevents motor neurons from releasing Acetylcholine.

i) What would the effect of botulinum toxin be on the muscles of an animal? (5 pts)

not paralyzed paralyzed & rigid paralyzed & limp

Explain your reasoning briefly.

ii) Would botulinum toxin cause numbness in the animal? (5 pts) yes no
Explain your reasoning briefly.

Question 3, continued:

c) Consider a synapse. In this synapse, the neurotransmitter released by the pre-synaptic cell causes neurotransmitter-gated **potassium** (K^+) channels to **open** in the post-synaptic cell. (circle your answers).

i) When these channels open, in which direction will the K^+ ions flow? (2 pts)

flow into cell flow out of cell

ii) What effect will this movement of ions have on the membrane potential (V_{M-})? (2 pts)

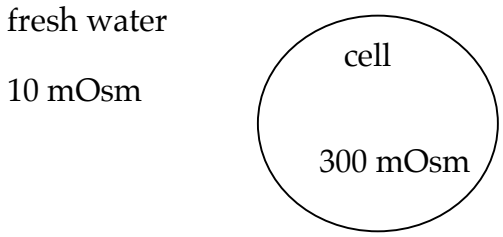
make V_M more + make V_M more –

iii) What type of synapse is this? (2 pts)

excitatory synapse inhibitory synapse

Question 4: Physiology (12 points)

a) Consider a cell in fresh water. This is shown below:



Which way will the **water** tend to move in this situation? Circle your answer and explain your reasoning. (4 pts)

- Water will move **into** the cell.
- Water will **neither** move into nor move out of the cell.
- Water will move **out** of the cell.

Explanation:

b) Consider an animal in **seawater** (1000mOsm); it has a problem with water loss to the surrounding seawater. For each of the following strategies, state whether or not this would solve the animal's water loss problem and explain your reasoning. (4 pts each)

i) The organism pumps water out of its cytoplasm into the surrounding seawater.

Would Would not

Explanation:

ii) The organism maintains a high concentration of amino acids in its cytoplasm so that there is the same amount of 'stuff' as in the seawater.

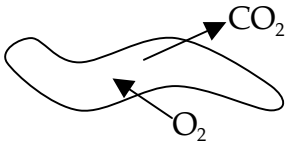
Would Would not

Explanation:

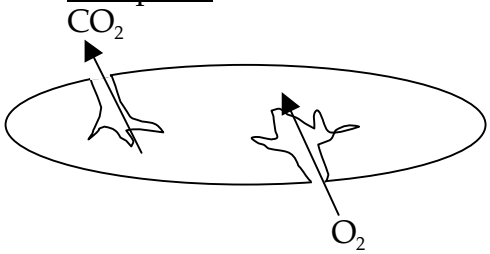
Bio 112 Solutions to Exam 3 from Spring 2008:

1) a) i) Nematode respires by diffusion through cuticle; caterpillar uses spiracles & tracheoles.

ii) <u>nematode</u>



<u>caterpillar</u>



b)

Nemertean worm	**jellyfish**
has brain/ganglion	doesn't
2 lateral cords ("ladder-like")	nerve net

c)

Nematode	**Planarian**
excrete via canals	excrete via flame cells
2 longitudinal nerve cords	4 longitudinal nerve cords
flow-thru digestion	gastrovascular cavity
mouth at head	mouth/anus at center
moves by undulation	moves by cilia

d)

Squid	**Sponge**
respire by gills	cells respire individually
has circulatory system	doesn't
has mouth	doesn't
mobile	sessile
has nervous system	doesn't
has flow-thru digestive system	done by individual cells

2) a) Sponge, planarian, starfish

b) None: sponge
Gastrovascular: jellyfish, planarian
Flow-thru: squid, trout, caterpillar, nemertean, earthworm, nematode, starfish

c) None: sponge, jellyfish, nemertean, planarian, nematode, starfish
One: trout
More than one: squid, caterpillar, earthworm

3) a)

	A	B	C
K^+ flow	out	out	out
Na^+ status	open	inactive	closed
Na^+ flow	in	0	0

b) i) Paralyzed and limp. Since no ACh can be released, the muscles cannot contract, so they will be paralyzed (unresponsive to brain control) and limp (always relaxed).

ii) No. ACh acts only in motor neurons, so blocking its release will not affect sensory neurons.

c) i) out of cell

ii) make V_m more -

iii) inhibitory synapse

4) a) Water will move into cell. Water moves from high water concentration (low mOsm) to low water concentration (high mOsm). Therefore, it will move into the cell.

b) i) This would not help. Since the organism's problem is water loss, pumping water out would make things worse.

ii) This would help. Since the cell and the surrounding fluid would be iso-osmotic, there would not be any net flow of water into or out of the cell.

Bio 112 Handout for Ecology 2

This handout contains:
- Today's iClicker Questions
- Handout for today's lecture

iClicker Question #30A - <u>before</u> lecture

Which of the following are true?

A. Populations in nature can increase at a constant rate.
B. Populations in nature can increase at an ever increasing rate.
C. Populations in nature can decrease.
D. All of the above
E. None of the above

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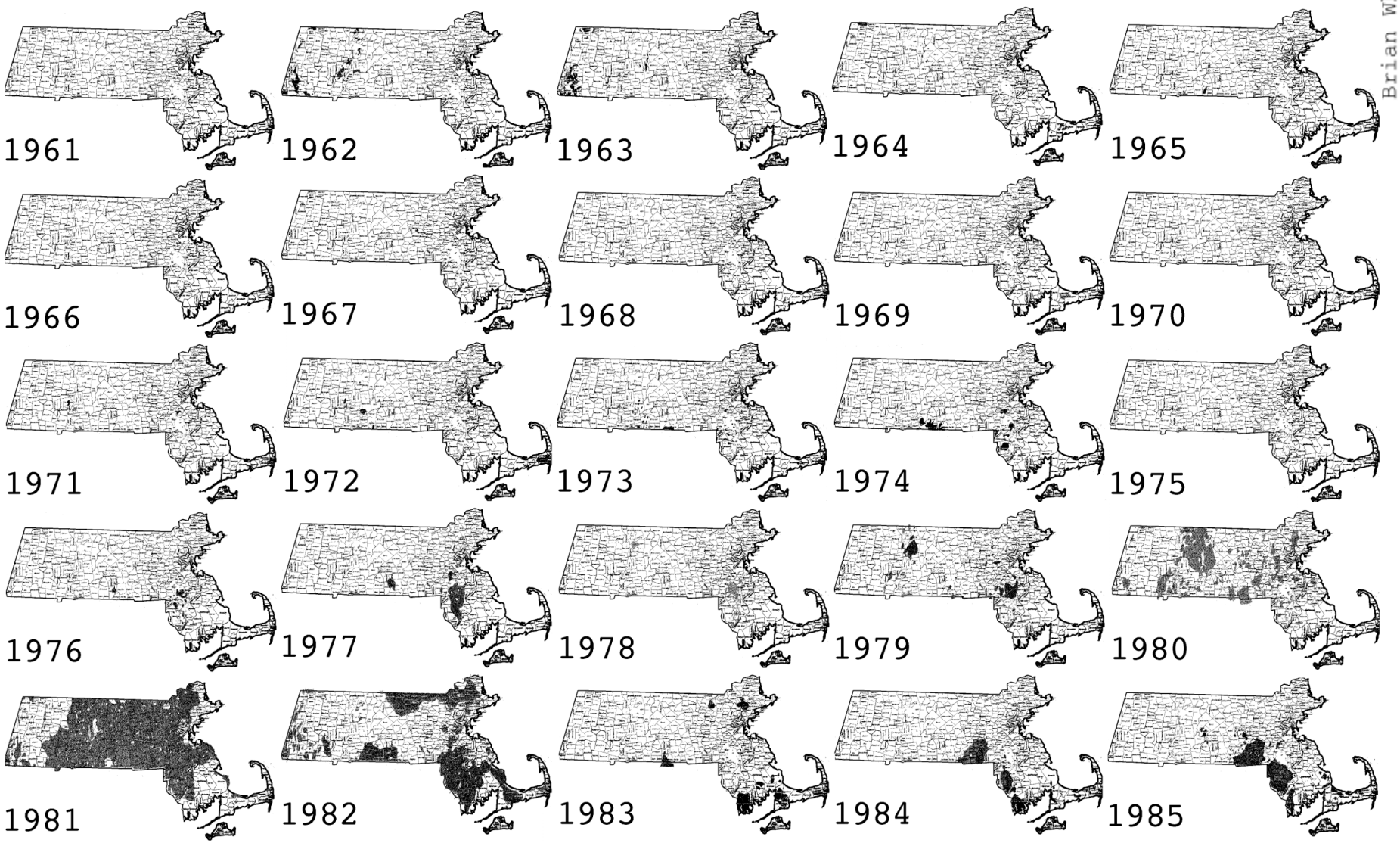
iClicker Question #30B - <u>after</u> lecture

Suppose that an island has K = 10,000 for mice. Under which of the following conditions would the growth rate be negative?

(A) N = 2
(B) N = 9,000
(C) N = – 500
(D) N = 25,000
(E) none of the above

<u>Beaming in your answers</u>

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
   a. Press the button corresponding to the answer you've selected (A thru E).
   b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.



Bio 112 Defoliation due to Gypsy Moth

Bio 112 Handout for Ecology 3

This handout contains:
- Today's iClicker Questions
- Handout for today's lecture

iClicker Question #31A - before lecture

Which of the following are examples of predation (in the Bio 112 sense)?

A. A cheetah eating a gazelle.
B. A tapeworm growing in your intestine.
C. The flu virus making you sick.
D. All of the above
E. None of the above

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iClicker Question #31B - after lecture

Suppose that the most complex model of the lynx/hare oscillation (#4) is correct. What would happen if you maintained a constant population of hares by adding or removing individuals as necessary?

(A) The lynx population would stop oscillating.
(B) The lynx population would continue to oscillate.
(C) I don't know.

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
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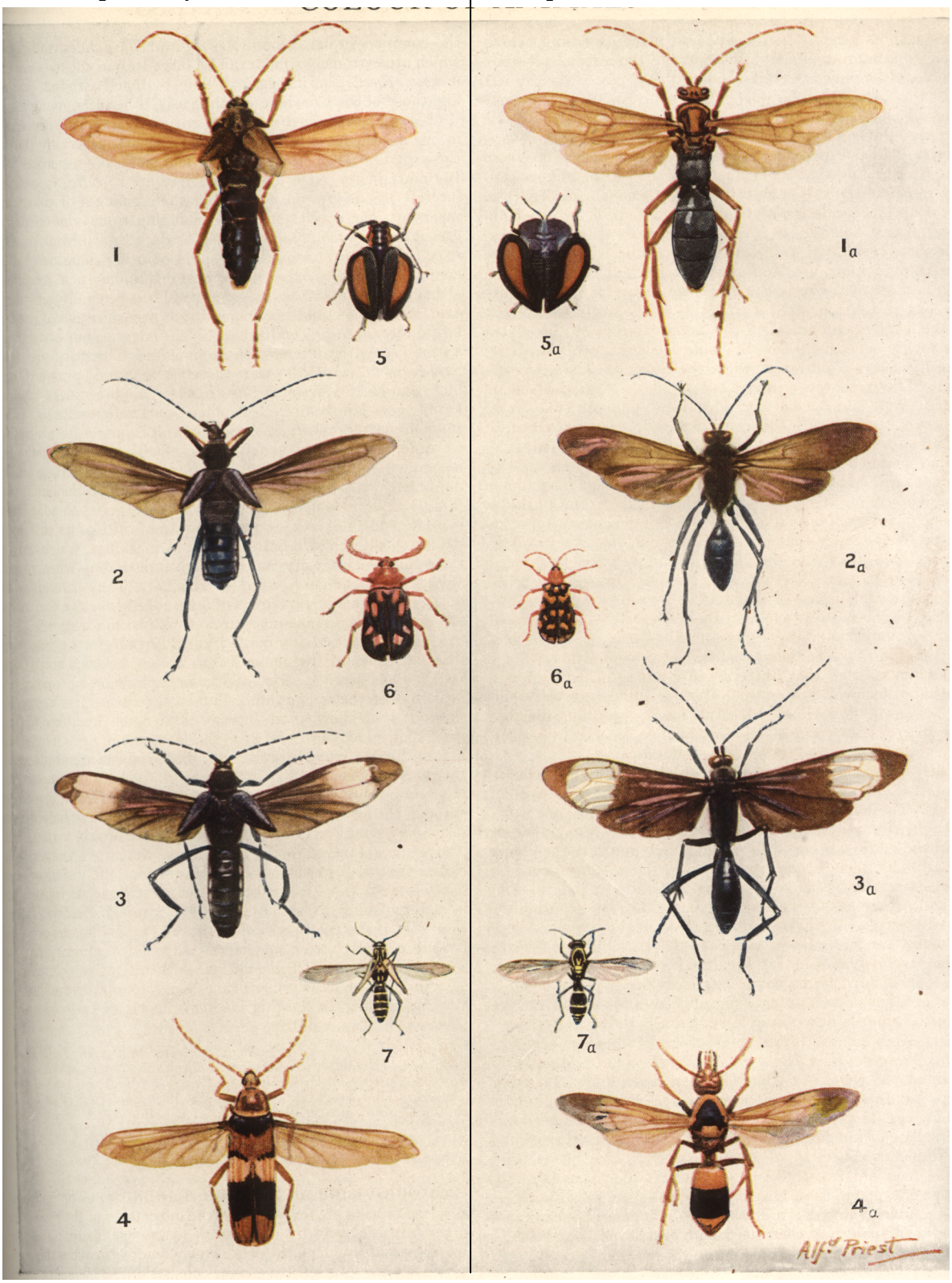
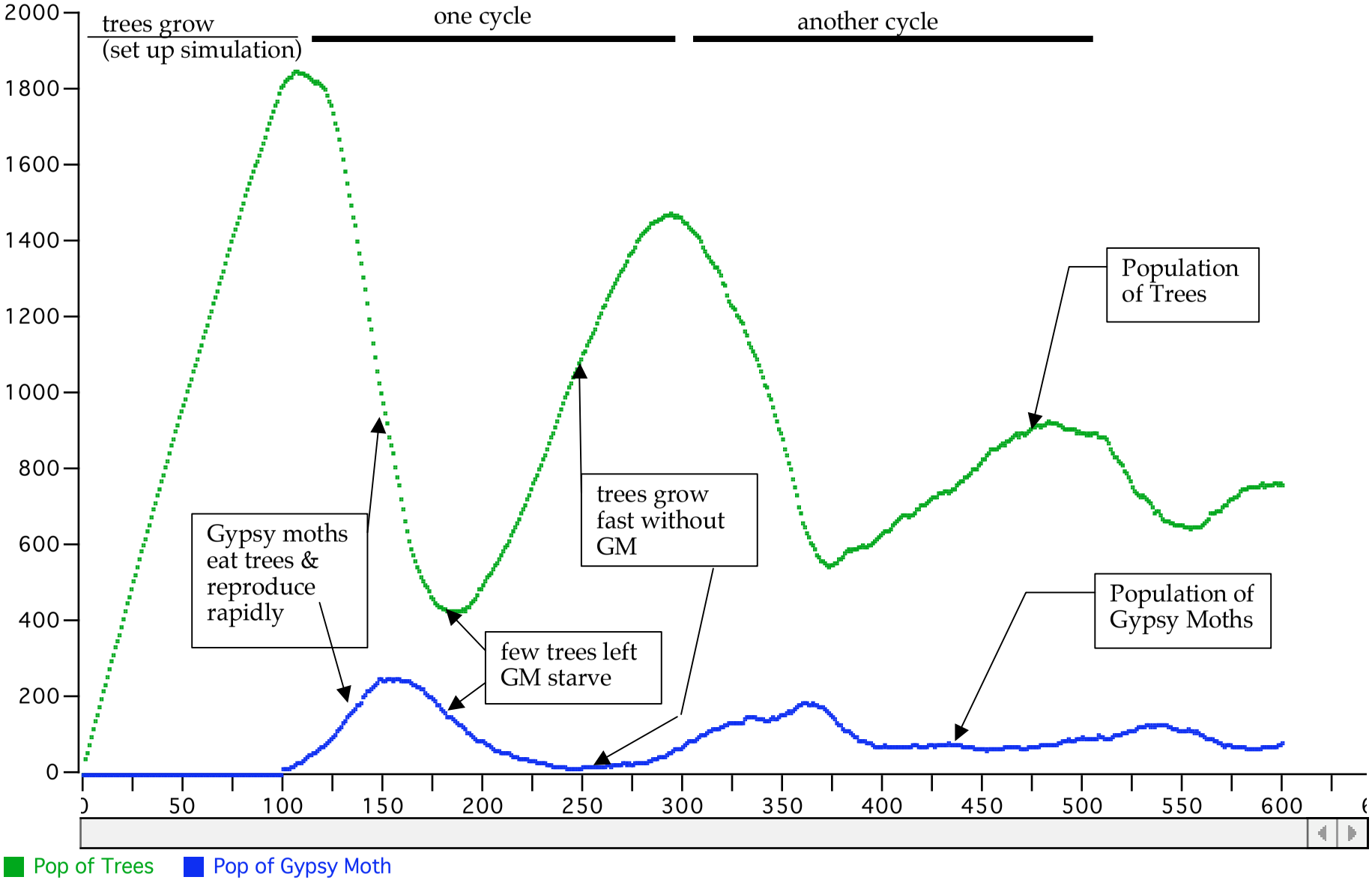
Bio 112 Mimicry

<u>Palatable Beetles (Mimics)</u>
- look like nasty ones but are perfectly edible {1-7}

<u>"Nasty" insects</u>
- wasps (stinging) {1a-4a & 7a}
- unpalatable beetles (taste bad) {5a & 6a}



Bio 112 Predator-Prey Oscillations



Name_____

TA_____ Section_____

Bio 112 & Current Research #2

- This assignment is designed to have you see how the material in Bio 112 applies to recent research.
- It is due at the start of class on Ecology 5; they will not be accepted late.
- TURN IN THIS COVER PAGE ONLY - that way, you'll have the data for the discussion.
- You should answer one of the questions below based on the first letter of our last name; your answer will be worth 10 points. (this will be the "Current Research II" mentioned on the syllabus)
- Please put your answer on this sheet; it does not need to be typed.
- Your answer **must be in your own words**.
- You will need to consult *Campbell* for reference.
- These questions are challenging; we will grade your answers generously.
- We will discuss the answers to these questions in lecture on Ecology 5.

I have attached a copy of an article from the journal *Science*. You should read it over and answer one of the questions below based on the first letter of your last name. Note that articles in *Science* are typically very condensed and therefore quite challenging to read. Most all of the information you need to answer any of the questions can be found early in the article; you can read the rest if you are interested.

Your answer can be short, as long as it is clear; two sentences should do the job.

In summary, the authors found that mosses can be fertilized by small insects. *Science* only publishes really 'hot' research, so this is a major finding.

a) **{Last names starting with A through G}** How did they know that the springtails and mites were fertilizing the mosses? Did they actually observe it happening? What was their measure of fertilization?

b) **{Last names starting with H through N}** Why did they have some vials without mites or springtails?

c) **{Last names starting with O through Z}** Why do they think that the mites and springtails are not just fertilizing the moss by accident? What evidence do they have this is not random?

⇒ Write the answer to your question below.

Question assigned: a b c

Microarthropods Mediate Sperm Transfer in Mosses

Nils Cronberg,[1]* Rayna Natcheva,[1,2] Katarina Hedlund[1]

The algal ancestors to all land plants were fertilized by sperm, which could freely swim between male and female structures in the aquatic environment. Some extant land plants, such as ferns, lycopods, horsetails, and bryophytes (mosses, liverworts, and hornworts), are still fertilized by sperm, whereas gymnosperms and angiosperms are fertilized by pollen, which is drought resistant and dispersed by wind or animals. Sperm are usually considered inefficient and poorly adapted to terrestrial conditions because of their dependency on a continuous water layer for dispersal.

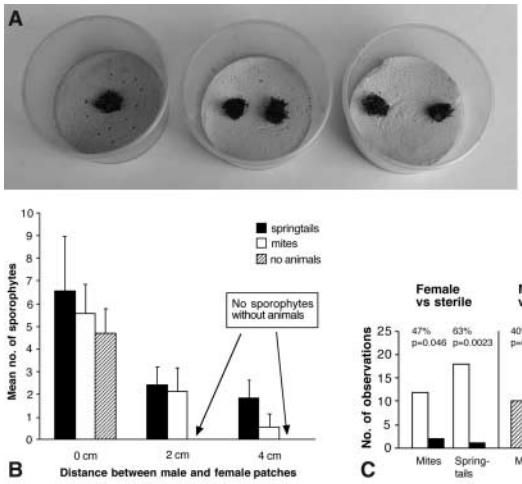
We designed a greenhouse experiment to test whether springtails or mites could mediate fertilization between spatially separated male and female mosses. Patches of male and female plants of a cosmopolitan unisexual moss (*Bryum argenteum* Hedwig) were positioned at three different distances, 0 cm (i.e., united), 2 cm, and 4 cm apart, in separate transparent plastic vials (Fig. 1A). A bottom layer of water-absorbing plaster of Paris served as a physical barrier for sperm. This design was replicated (n = 7) for three different treatments: (i) with actively moving springtails (*Isotoma caerulea* Bourlet), (ii) with slower moving oribatid mites [*Scutovertex minutus* (C. L. Koch) and *S. sculptus* Michael], and (iii) without animals. Successful fertilization was expected to result in production of sporophytes physically attached to the mother shoots.

After 3 months, abundant sporophytes were found in vials in which male and female patches were united, where sperm could swim freely (Fig. 1B). No fertilization was observed in the treatment without animals and where the sexes were kept apart at 2 and 4 cm, confirming that sperm were unable to disperse on their own. Numerous sporophytes were produced when animals were present and when moss patches were spatially separated, demonstrating that both springtails and mites were capable of transporting sperm across both distances. The means of this transport is an open question, but presumably the sperm adhere to arthropod cuticle somehow. The results also confirm that distances of sperm transfer between mosses are related to the mobility of the animals, because the test with the more-mobile springtails gave a higher fertilization success at a greater distance.

These observations raise the question of whether animal-mediated fertilization results from passive random movements or active visits to fertile structures, similar to visits of pollinators to flowers. To test this, we conducted a series of preference experiments. In separate sets of vials, we allowed animals to choose between male fertile versus sterile shoots, between female fertile versus sterile shoots, and also between fertile shoots of both genders. Both springtails and mites preferred fertile to sterile shoots (Fig. 1C). We do not know the reason for the attraction, but it may be because fertile shoots are a source of food, because they not only secrete sucrose (*1*) but also starch, fatty acids, and mucilage (*2–4*).

Our results suggest that a mutualistic relationship exists between bryophytes and microarthropods. About 50% of moss species are unisexual, having male and female structures on different individuals, which means that fertilization success is distance-dependent and often limited by the availability of mates. When water is scarce and a continuous water film is lacking, animal-mediated sperm transfer seems to be the only possible mode of fertilization, even in bisexual and potentially self-compatible species.

The origin of animal-mediated fertilization has been assumed to involve angiosperms and insects (insect pollination), although angiosperms first emerged during the early Cretaceous (circa 140 million years ago), and some of the insect groups involved in pollination appear to have radiated well before this period (*5*). It is hypothesized that insect pollination started as pollinivory (pollen consumption) and then evolved toward more-complex mutualistic relationships (*6*). Mosses, springtails, and mites are extant representatives of taxa that originated after the early phase of land colonization (circa 440 to 470 million years ago). Animal-mediated fertilization in mosses therefore potentially antedates similar syndromes in other plant groups.



Note that a clearer version of this figure can be found on the back of this page.

Fig. 1. Fertilization of moss shoots by mites and springtails. (**A**) Vials with male and female moss patches united or separated by 2 and 4 cm. (**B**) Sporophyte production in female moss patches in presence versus absence of springtails or mites. Fertilization was achieved when patches of different sexes were united and, when spatially separated, exclusively in the presence of animals. Each bar represents the mean number of sporophytes in seven replicates (error bars represent one standard error). (**C**) Preference experiment (two-choice test) in which mites and springtails were allowed to choose between fertile and sterile moss shoots. Percentages represent the proportion of 30 replicates in which animals were present on the moss shoots. Bars show the numbers of animals present on fertile or sterile shoots. Significance levels of G tests are also given.

References and Notes

1. W. Pfeffer, *Untersuchungen aus dem botanischen Institut in Tübingen* 1, 363 (1884).
2. R. J. Harvey-Gibson, D. Miller-Brown, *Ann. Bot.* (London) **41**, 190 (1927).
3. D. J. Paolillo, *Bryologist* **82**, 93 (1979).
4. K. Renzaglia, D. J. Garbary, *Crit. Rev. Plant Sci.* **20**, 107 (2001).
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7. We thank S. Andersson, W. van der Putten, and R. Wyatt for helpful comments on the manuscript. N.C. acknowledges support from the Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning (FORMAS).

Supporting Online Material
www.sciencemag.org/cgi/content/full/313/5791/1255/DC1
Materials and Methods
Tables S1 and S2

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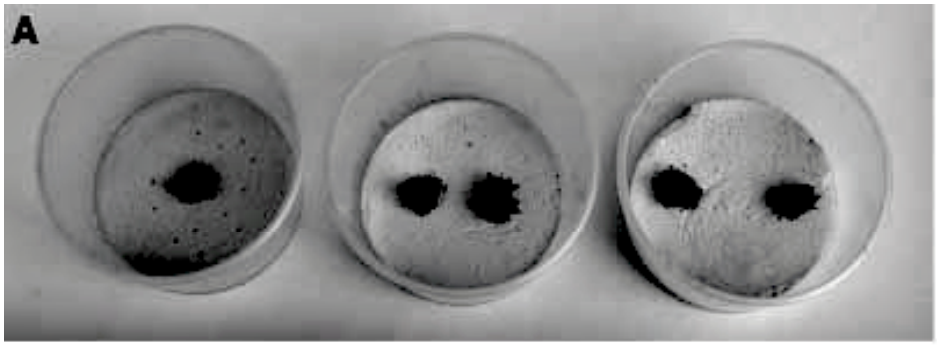
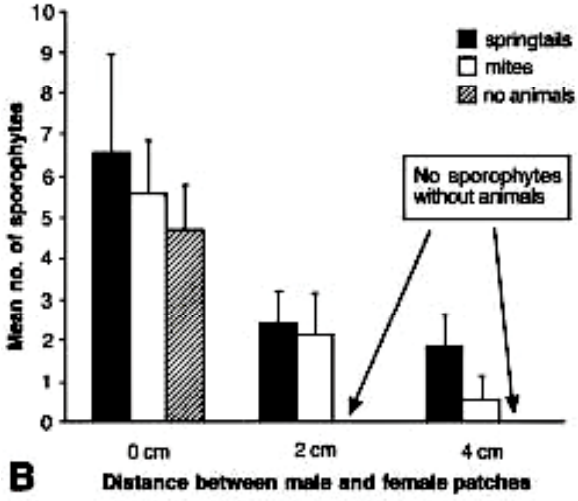
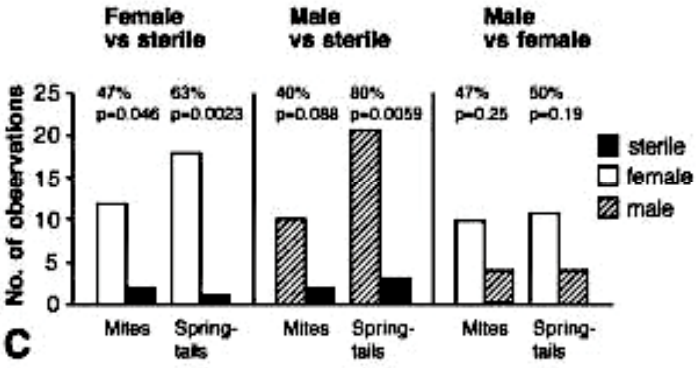






Bio 112 Handout for Ecology 4

This handout contains:
- Today's iClicker Questions
- Research #3

iClicker Question #32A - before lecture

Which of the following are examples of competition (in the Bio 112 sense)?

A. A maple tree growing taller than and shadowing a shorter pine tree.
B. Lions and cheetahs both eating gazelles.
C. Two species of barnacles occupying the same part of a rock.
D. All of the above
E. None of the above

---

iClicker Question #32B - after lecture

When a forest borders an open grassland, small mammals (mice, moles, etc.) are only found in the forest. In the absence of predators, these small mammals are found in the grassland as well. Based on this, what is the fundamental niche of mice?

(A) grassland only
(B) grassland and forest
(C) forest only
(D) none of the above
(E) I don't know

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
   a. Press the button corresponding to the answer you've selected (A thru E).
   b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

Bio 112 Research #3

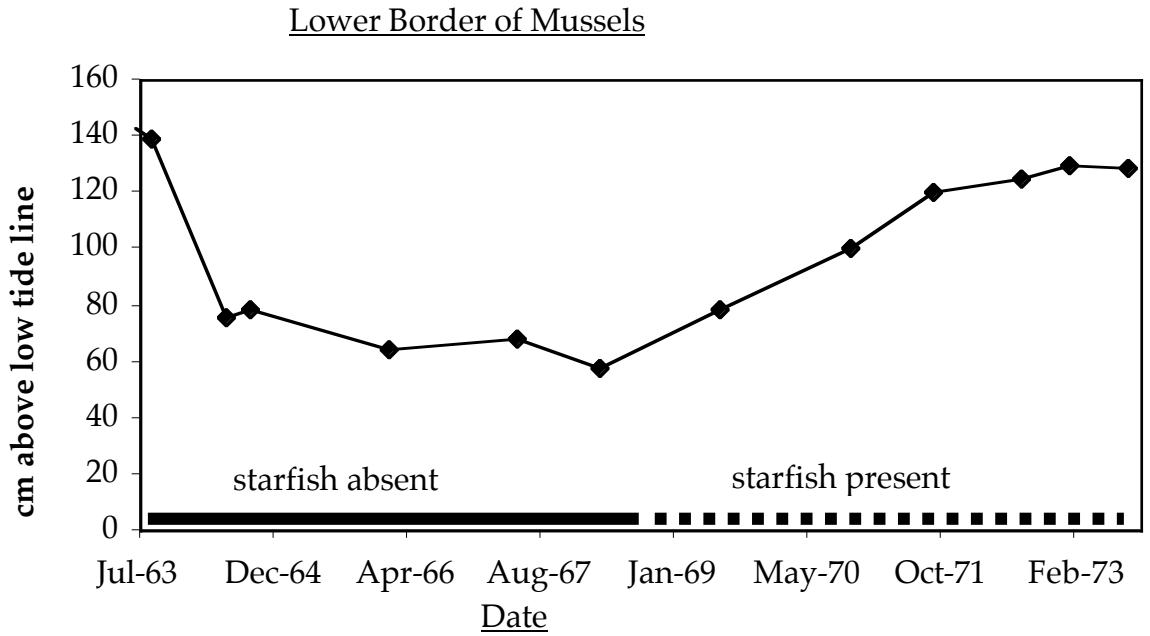
- This assignment is designed to get you thinking about some of the data we'll be discussing in class.
- It is due at the start of class on Friday Ecology 6; they will not be accepted late.
- You should answer all of the questions that follow; your answer will be worth 10 points.
- Please put your answer on a separate sheet of paper with your name and your TA's name; it does not need to be typed.
- Your answer **must be in your own words**.
- You may need to consult Campbell for reference.
- These questions are challenging; we will grade your answers generously.
- We will discuss the answers to these questions in lecture on Ecology 6.
- Please bring this handout to lecture on Ecology 6.

The rocky intertidal zone has been studied extensively by ecologists because it is complex, easily accessible, and the organisms that live there are easily manipulated (since they don't move around much). Campbell figure 52.18 shows a photograph of the intertidal zone; figure 54.3 shows a sketch of the same. A description of the experiments in this question can be found on page 1199-1200 of Campbell.

Briefly, the starfish *Pisaster ochraceous* , eats the mussel *Mytilus californianus* (see figure 54.15). *Pisaster* can come out of the water for only brief periods of time; *Mytilus* can be dry for longer periods, but must be wet for at least some of the day. Thus, they both occupy overlapping horizontal bands along the rocks.

Briefly, the starfish *Pisaster ochraceous* , eats the mussel *Mytilus californianus* (a mollusc that is similar to a clam). *Pisaster* can come out of the water for only brief periods of time; *Mytilus* can be dry for longer periods, but must be wet for at least some of the day. Thus, they both occupy overlapping horizontal bands along the rocks.

Robert Paine and his co-workers measured the lower limit of the *Mytilus* band from a particular region of the rocky intertidal zone in Washington State from July of 1963 to September 1973. From June of 1963 through June of 1968, they went out to the rocks every month and removed all the *Pisaster* they could find. After July of 1968, they let the *Pisaster* return. The upper limit of the *Mytilus* band did not change during this experiment. Their data are shown below:



1) What is the approximate lower limit of *Mytilus'* Fundamental Niche?

2) What is the approximate lower limit of *Mytilus'* Realized Niche?

3) Why does the removal of the *Pisaster* only affect the lower border of the *Mytilus*

Paine et al also looked at the % of the total space on the rocks that was occupied by each different species before, during, and after the *Pisaster* removal. Their data are shown below:

Organism	**July 1963**	**August 1966**	**March 1968**	**June 1971**	**April 1973**
none	11	0	0	0	0
barnacles	47	5	5	0	0
mussles	1	95	95	100	100
seaweeds	30	0	0	0	0
sponges	5	0	0	0	0

On a similar plot, they did not remove *Pisaster* and they saw:

Organism	**July 1963**	**August 1966**	**March 1968**	**June 1971**	**April 1973**
none	10				14
barnacles	41				38
mussles	5				2
seaweeds	38				36
sponges	5				5

These data are related to the data presented in Campbell figure 53.16b.

4) Describe these results: what kinds of creatures were found on the rocks before the *Pisaster* were removed and what kinds were found during the removal?

5) Why did removing the *Pisaster* have the effect that you described in your answer to question (4)?

6) Why did they have to collect data from a plot where *Pisaster* were not removed? That is, what explanation(s) does the result of this control experiment rule out?

Note: you can find all these data in the original paper (which is quite readable) in the journal Oecologia (it is in the UMB library) volume 15, pages 93 to 120.

Bio 112 Handout for Ecology 5

This handout contains:
- Today's iClicker Questions
- Information for the Final Exam

iClicker Question #33A - before lecture

Which of the following are examples of mutualism (in the Bio 112 sense)?

A. Bacteria growing in the stomach of a cow; the bacteria process cellulose in the cow's food and the cow utilizes nutrients released by the bacteria.
B. Cows eating grass; the cow's manure is not used to fertilize the field.
C. Cheetahs eating gazelles.
D. All of the above
E. None of the above

---

iClicker Question #33B - after lecture

If I wanted to maximize the diversity in a large area of land. How often should I let fire burn away all the vegetation?

(A) let it all burn completely and often
(B) let parts of it burn occasionally
(C) never let it burn

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
   a. Press the button corresponding to the answer you've selected (A thru E).
   b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

Bio 112 Final Exam Tips

• The exam will be held in Lipke.
• The exam will cover reading, lab, and lecture of the entire course as described below.
  – roughly 40% of the test will cover Ecology (1 thru 8)
  – roughly 60% of the test will cover the whole course.
• The exam will consist of approximately 6 questions. These will not be multiple choice; they will be problem-solving or short answer. In general, the questions will expect you to apply and make connections between the things I have talked about in lecture. The final exam from Spring 2001 can be found in this handout; solutions are attached.

Exam I Material (Evolution):
You need to know everything listed on the Exam I Information Sheet (Themes 2 handout)
EXCEPT:
• How to solve Population Genetics Problems
• How to explain a graph of genotype/allele frequencies
• How species are formed (anagenesis/cladogenesis, pre/post zygotic)
⇒ The questions from Exam I that are most like those that could be on the final are
1, 2b, and 3.

Exam II Material (Plants & Themes):
You need to know everything listed on the Exam II Information Sheet (Animals 3 handout)
EXCEPT:
• basic genetics applied to plants
• How to calculate ratios of size & scale (Exam 2 Question 3a)
⇒ The questions from Exam II that are most like those that could be on the final are
1, 2, 3, and 4.

Exam III Material (Animals & Physiology):
You need to know everything listed on the Exam III Information Sheet (Ecology 1 handout)
EXCEPT:
• The mechanisms of stimulatory & inhibitory effects on neurons
⇒ The questions from Exam III that are most like those that could be on the final are
1, 2, 3, and 4.

Ecology Material
– You need to know:
• population growth: exponential & logistic at the level of detail in lecture (& effects on N & K)
• how to recognize & apply predation/parasitism, competition, and mutualism
• niches (fundamental & realized) & how to measure them experimentally
• predator/prey oscillations • coevolution • mimicry
• succession & disturbance effects on communities
• the overall equations for cellular respiration & photosynthesis
• tropic levels, production efficiency (the "10% rule") & where the carbon goes
• biogeochemical cycles: balancing flows, effects of changes, closed loops

– You **do not** need to know:

- climate
- the specific steps in any successional series
- the specific details of any examples from lecture
- details of biogeochemical cycles

⇒ This part of the exam will consist of questions like:

– "Describe what is happening in the various parts of this population growth graph"
– "Given this food chain, how many grams of X production is required to make one gram of Y?"
– "[description of interaction], is this predation, parasitism, competition, etc?"
– "[description of situation], what are the realized & fundamental niches of species Y?"
– etc.

Other types of questions that could be found on the final (among others not listed):
– "A friend says he's found a pine flower, is he crazy? Why/why not?" Same for animals.
– You should know the kingdom and phylum of the creatures I described in detail in the Plant Diversity and Animal Diversity sections of the course.

"Cheat Sheets": You will be allowed to bring in up to 4 sheets of paper (8.5 x 11) with anything you want written on them. You may keep these sheets; we will not collect them.

Supplementary Information for Final Exam

"Pizza Parlor Phylogeny"

This sheet describes some information to add to the Information for the Final Exam found on page 2 and 3 of the handout for Ecology 5. Everything on those sheets still applies to the Final Exam, **except** anywhere that says that you don't have to know the "specific classification of any organism". You still don't need to know the complete classification (kingdom, phylum, family, etc.) of any organism, but you will need to be able to answer a question like the following:

> "Consider a pizza with broccoli and mushrooms. Name 4 organisms, each from a different phylum, that are represented in this pizza. For each organism, give the phylum to which it belongs

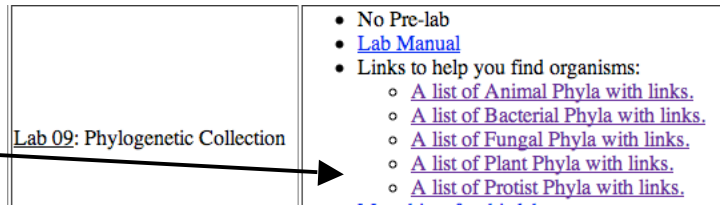
- Organism 1_____ Phylum_____
- Organism 2_____ Phylum_____
- Organism 3_____ Phylum_____
- Organism 4_____ Phylum_____

The pizza on the exam will likely be different than the one described above. However, the pizza will only contain items from the following list:

- bread (wheat, yeast, etc.)
- mozzarella cheese (milk)
- mushrooms
- hamburger
- clams
- pine nuts (seeds of the pinion pine tree)
- tomato sauce (tomato, oregano, basil, garlic)
- broccoli
- green pepper
- pepperoni (pork, pepper, other spices)
- squid

To count as "containing" a particular organism, at least part of that organism or something produced by that organism must be present in the pizza. For example, although cockroaches (phylum *arthropoda*) may sometimes *eat* pizza, they are not usually found *on* a pizza, so you would not get credit for listing cockroaches.

You should use Campbell and the links in the On-line Lab Manual for the Phylogenetic Collection Lab as references for phyla and the organisms in them.



To prepare: you will find it useful to put a list of the ingredients from the list above and the phyla present in each on your cheat sheet.

Bio 112 Final Exam

5/23/01

Your Name:_____ TA's Name:_____

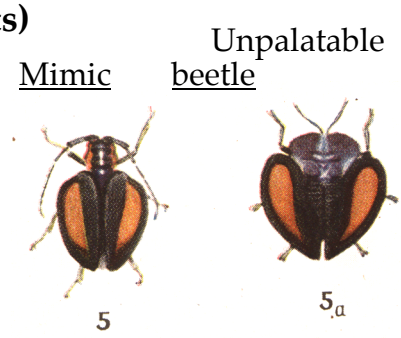
Write your name on every page in the space provided.
This exam has 10 pages including this coversheet.
Check that you have pages 1-10.

This exam has five questions.

Make your answers as clear and precise as possible.
Answer all questions in the space provided.

Question	Value	Score
1	16	_____
2	27	_____
3	27	_____
4	14	_____
5	16	_____
TOTAL:	100	_____

Question 1: Evolution & the History of the Earth (16 points)



a) The picture at the right shows two similar-looking insects. The beetle on the right is unpalatable - it tastes bad and birds rapidly learn not to eat it. The beetle on the left is a mimic, it tastes just fine to birds, but since it resembles the unpalatable beetle, birds do not eat it.

i) To which kingdom and phylum (according to Five Kingdoms) do these two insects belong? (1 pt each)

Kingdom_____ Phylum_____

ii) Assuming that the ancestors of the mimic did not look like the unpalatable beetle, provide a plausible explanation for how the ancestors of the mimic came to look like the unpalatable beetle by a process of **natural selection**. (8 pts)

b) Put the following 3 events in the proper order. Indicate your answer by writing the corresponding number of the event in the blanks provided. (3 pts)

#	Event
1	First whales in water
2	First fish in water
3	First mammals on land

first event #:_____ next event #:_ last event #:_____

c) Put the following 3 events in the proper order. Indicate your answer by writing the corresponding number of the event in the blanks provided. (3 pts)

#	Event
1	First bacteria
2	First photosynthesis
3	First eukaryotes

first event #:_____ next event #:_ last event #:_____

Question 2: Life Cycles (27 points)

a) In the space below, draw the life cycle of a **flatworm**. Your drawing need not show the parts as they actually appear, but it must show the correct relationships between the parts and be **neat and legible**. You must include asexual reproduction - cutting the worm into two pieces and having each piece grow into a fully-functional worm. Be sure to include the following wherever appropriate; you should use each of these at least once:

Parts	Processes	Features
- zygote	- mitosis	- haploid
- gamete	- meiosis	- diploid
- adult worm	- cutting	- single cell
- cut pieces	- fertilization	- many cells
	- re-generation	

(12 pts)

You may use the back of this page for scrap.

Question 2 , continued:

This is for scrap; we will not grade what you write on this page.

Question 2, continued:

b) Complete the following table.

– For the moss:

- if the 'thing' is part of the moss life cycle, check "present" and name the corresponding part of the life cycle – if there is more than one part, give only one part.
- if the 'thing' is not part of the moss life cycle, check "not present"

– For the human:

- if the 'thing' is part of the human life cycle, check "present".
- if the 'thing' is not part of the human life cycle, check "not present"

"Thing"	**Moss** (2 pts each)	**Human** (1 pt each)
Single **haploid** cell which is capable of growing into a group of haploid cells.	☐ not present ☐ present Name if **present**:	☐ not present ☐ present (No name is necessary)
Single **haploid** cell that is **not** capable of growing on its own, but can join with a particular other haploid cell to form a diploid cell.	☐ not present ☐ present Name if **present**:	☐ not present ☐ present (No name is necessary)
An organism composed entirely of **haploid** cells.	☐ not present ☐ present Name if **present**:	☐ not present ☐ present (No name is necessary)
A single **haploid** cell produced by meiosis.	☐ not present ☐ present Name if **present**:	☐ not present ☐ present (No name is necessary)
A dormant form of the organism that can be stored without food or light for many months, but can grow into an organism when provided with food.	☐ not present ☐ present Name if **present**:	☐ not present ☐ present (No name is necessary)

Question 3: Animals & Plants (27 points)

a) Give 3 **differences** between a **single grain of pine pollen** and a **single human sperm**. Note that one of your differences **may not** be "pine pollen comes from a plant and human sperm comes from an animal".

(1) (1 pt)

(2) (2 pts)

(3) (3 pts)

b) Give one **similarity** between a **single grain of pine pollen** and a **single human egg**. (3 pts)

c) Give **three** major **differences** between a grain of **pine pollen** and a **moss spore**.

(1) (1 pt)

(2) (2 pts)

(3) (3 pts)

Question 3, continued:

d) A friend tells you that he has found the following animal parts or features. For each animal part or feature: (1 pt each)

- circle **possible** if this animal part or feature could exist; no explanation is necessary
- circle **impossible** if this animal part or feature could not exist; no explanation is necessary

i) Asexual reproduction of an entire sponge (not just regeneration of a part).	Possible	Impossible
ii) A gill from an earthworm.	Possible	Impossible
iii) A chloroplast from a flatworm (planarian).	Possible	Impossible
iv) More than one heart from a squid.	Possible	Impossible
v) A nematode mating.	Possible	Impossible
vi) The brain of a trout.	Possible	Impossible
vii) The kidney of a planarian.	Possible	Impossible

e) Consider the following statement:
"Considering the animals described in lecture and excluding jellyfish, vertebrates are the only animals that breathe through their mouths." True or false? Circle the right answer and explain your reasoning. (5 pts)

True False

Reasoning:

Question 4: Ecology (14 points)

All parts of this question refer to the following situation. These data come from studies done recently in upstate New York. They involve 5 species:

– Oak Trees:
- produce fruits called **acorns**.

– Gypsy moths:
- eat leaves of **oak** trees

– Mice:
- prefer to eat **acorns**; will also eat **gypsy moth caterpillars**

– Ticks:
- live on **mice**; drink their blood

– Lyme Disease bacteria:
- live in **ticks**
- if **ticks** bite humans, humans get Lyme disease

a) To which phylum (using the Five Kingdoms system) does each of the following organisms belong? (1 pt for each blank)

i) Gypsy moths _____

ii) Mice _____

b) Give the trophic level (primary producer, secondary consumer, etc.) of each of the following organisms: (1 pt each)

i) Oak trees _____

ii) Gypsy moths _____

iii) Ticks (note that there are two possible answers here; give **both**)

_____ _____

c) What is the relationship between the **ticks** and the **mice**. Circle one. (1 pt)

mutualism competition predation/parasitism

d) Assuming that the mice eat all the acorns they gather, what is the relationship between the **mice** and **oak trees**. Circle one. (1 pt)

mutualism competition predation/parasitism

Question 4, continued:

These questions refer to the community described on the previous page.

• Every 2 to 5 years, there is an abundant crop of acorns. A year where there is a large crop of acorns is called a 'mast year'.

e) During a mast year, a larger number of humans contract Lyme disease than during other years. Explain this observation. (3 pts)

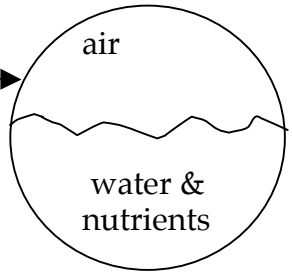
f) Following a mast year, there is often a great increase in the gypsy moth population. Explain this observation. (3 pts)

You should not need to write below this line.

Question 5: Ecosystems (16 points)

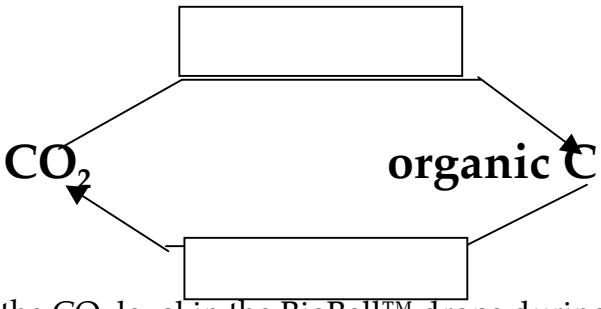
Consider the following theoretical ecosystem, the BioBall™.

- completely enclosed in a glass sphere
- only light can get in
- only heat can get out



Contains 2 organisms only:
- **plant** that lives in water
- **snail** that eats plant

a) Shown below is the carbon cycle for the BioBall™. Indicate where each organism participates in this cycle by writing "plant" or "snail" in the boxes as appropriate. (6 pts)



b) You observe that the CO_2 level in the BioBall™ drops during the daytime and rises during the nighttime. Explain this observation. (5 pts)

c) Consider the nitrogen cycle in the BioBall™ and what you know about biogeochemical cycles.

- the plants take in NO_3^- and convert it to organic N
- the snail eats orgnaic N and excretes NH_4^+

This is not stable for the long term, since the NO_3^- will run out and toxic NH_4^+ will build up. You have several choices to remedy this situation:

(1) add NO_3^- fertilizer whenever NO_3^- gets low
(2) add a bacterium that can live in the BioBall™ and can convert NH_4^+ to N_2.
(3) add a bacterium that can live in the BioBall™ and can convert N_2 to NO_3^-.
(4) add a bacterium that can live in the BioBall™ and can convert NH_4^+ to NO_3^-.

Which of these is the best choice to ensure the long-term stability of the organisms in the BioBall™? Write the number of your answer in the box and explain your reasoning below. (5 pts)

Explanation:

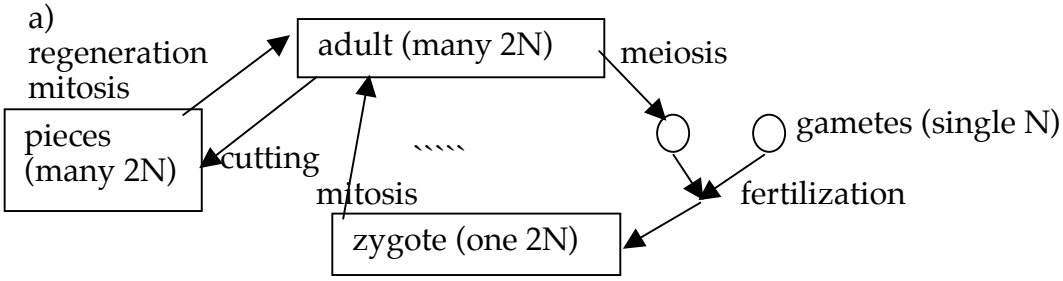
Solutions to Final Exam from Spring 2001

1) a) i) kingdom: animalia phylum: arthropoda
ii) there were 4 parts to a complete answer.

- <u>Pre-existing variation</u>: some ancestors of the mimic (5) looked one way while others looked like the unpalatable beetle (5a).
- <u>Variation is genetic</u>: the color pattern is inherited.
- <u>One genotype at an advantage</u>: beetles that look like the unpalatable one are not eaten as much and therefore have more offspring.
- <u>Increase in population</u>: because the ones that look like the unpalatable beetle have more offspring, their genotype takes over the population. The result is a species of mimic beetle.

b) 231 c) 123

2) a)



b)

<u>moss</u>	<u>human</u>
present: spore	not present
present: sperm	present
present: g'phyte	not present
present: spore	present
present: spore	not present

3) a)

pine pollen	human sperm
4 cells	one cell
can't swim	swim
doesn't fertilize egg	fertilizes egg
made by mitosis	made by meiosis
is a g'phyte	isn't

b) both are haploid

c)

pine pollen	moss spore
4 cells	1 cell
g'phyte	spore
grows to pollen tube	grows to g'phyte plant
not for dispersal	for dispersal
made in male cone	made in sporangium
made by mitosis	made by meiosis

d) Possible: (i), (iv), (v), (vi) Impossible: (ii), (iii), (vii)

e) True. All others breathe through skin or gills that are external to the mouth.

4) a) i) mandibulata ii) craniata

b) i) 1° producer ii) 1° consumer iii) 2° or 3° consumer

c) predation/parasitism d) predation/parasitism

e) increasing acorns ⇒ increase in mice ⇒ increase in ticks ⇒ increase in lyme disease

f) more acorns feed mice so they don't need to eat the gypsy moths ⇒ more gypsy moths

5) a) top: plant bottom: snail

b) in daytime, lots of photosynthesis ⇒ lower CO_2; at night, less photosynthesis so respiration increases CO_2

c) bacteria (#4) - complete the cycle by using up the NH_4^+

$$NO_3^- \xrightarrow{\text{plants}} \text{organic N} \xrightarrow{\text{snail}} NH_4^+$$

Bio 112 Handout for Ecology 6

This handout contains:
- Today's iClicker Questions

iClicker Question #34A - <u>before</u> lecture

Considering the data presented in the handout from Ecology 4, what is the approximate lower border of *Mytilus'* Realized niche?

A. 20 cm
B. 60 cm
C. 80 cm
D. 140 cm
E. None of the above

---

iClicker Question #34B - <u>after</u> lecture

During El Niño, when the water temperature is lower, what would you expect to happen to the diversity of the intertidal communities where *Pisaster* is usually present?

(A) diversity would increase
(B) diversity would not change
(C) diversity would decrease
(D) none of the above
(E) I don't know

<u>Beaming in your answers</u>

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iCliker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
    a. Press the button corresponding to the answer you've selected (A thru E).
    b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

Bio 112 Handout for Ecology 7

This handout contains:
- Today's iClicker Questions

iClicker Question #35A - before lecture

Which of the following are examples of biomass?

A. The mass of organic material in a tree.
B. The mass of organic material in the soil.
C. The mass of organic material in you.
D. More than one of the above.
E. None of the above

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iClicker Question #35B - after lecture

An elephant loses roughly 54% of food intake as feces and 45% through respiration, leaving 1% for growth. If the elephant were cold-blooded rather than warm-blooded, it would be more efficient at converting food to more growth. In this case, which of the following changes would be correct (assuming that they consume the same amount of food as the warm-blooded version):

A. The **respiration** of the cold-blooded elephant would be **higher** than the respiration of the warm-blooded elephant.
B. The **respiration** of the cold-blooded elephant would be **lower** than the respiration of the warm-blooded elephant.
C. The **feces** of the cold-blooded elephant would be **higher** than the respiration of the warm-blooded elephant.
D. The **feces** of the cold-blooded elephant would be **lower** than the respiration of the warm-blooded elephant.
E. I don't know

Figure out your answer and select the appropriate number (1-5) then beam in your answer.

Bio 112 Handout for Ecology 8

This handout contains:
- Today's iClicker Questions
- Figure for today's lecture

iClicker Question #36A - before lecture

Last one!

On average, what fraction of the biomass eaten by an animal ends up as biomass in that animal?

A. 100%
B. about 75%
C. about 10%
D. 0%
E. None of the above