

BIOL 1114 Exam #4 (Preview) December 11, 2017

Use a #2 pencil to fill in the information on your NCS answer sheet.

1. Put your **O-Key Account Username** in the spaces indicated for LAST NAME and darken the corresponding circles.

2. **Write your Name** (Last, First) and the word "**Star**" or "**NoStar**" above the words "Last Name".

3. Put your **CWID** in the spaces indicated for "**Student ID**" and darken the corresponding circles.

4. Enter **1734** in the spaces indicated for "**Course number**" and darken the corresponding circles.

5. Enter **001(Star)** OR **002(NoStar)** in the spaces indicated for "**SEC**" and darken the corresponding circles.

Failure to perform this correctly will incur a -10 pt handling fee. Read all questions and answers *carefully* before choosing the **single BEST response** for each question. Feel free to ask the instructor for clarification.

mRNA-Codon-to-Amino-Acid Decoder Chart									
1 st Letter	2 nd Letter								3 rd Letter
	U		C		A		G		
U	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine	UCA		UAA	STOP	UGA	STOP	A
UUG	UCG		UAG	UGG	Tryptophan		G		
C	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Glutamine	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	Lysine	AGA	A	
	AUG	Methionine; START	ACG		AGG		Arginine	G	
G	GUU	Valine	GCU	Alanine	GAU	Aspartate	GGU	Glycine	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glutamate	GGA		A
	GUG		GCG		GAG		GGG		G

important equations: $r = b - d$ $G = r N$ $G = r N [(K-N)/K]$
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You and a friend decide to race your pet tarantula and mouse. You race them today and the race ends in a tie. You decide to race them again tomorrow, when the temperature will be 10 °C cooler.

A rabbit stays in the sunlight for a long time. Eventually the **body temperature** of the rabbit increases by 5 °C.

A beaker is divided into two halves, A & B, by a membrane that is freely permeable to water but not to protein. Side A is half-filled with a solution of 8% protein, while side B is half-filled with a 2% protein solution.

An experiment to measure the rate of respiration in eastern lubber grasshoppers (*Romalea guttata*) and similarly sized house mice (*Mus musculus*) at room temperatures of 10°C and 25°C was performed using a respirometer, an apparatus that measures changes in gas volume. Respiration was measured in mL of O₂ consumed over several five-minute trials and the following data were obtained.

Organism	Temperature (°C)	Average respiration (mL O ₂ /min)
Mouse	10	0.0518
Mouse	25	0.0321
Grasshopper	10	0.0013
Grasshopper	25	0.0038

Chlorpyrifos is an insecticide used in Insect Pest Management (IPM) in many regions of the United States. Chlorpyrifos attaches strongly to soil particles and erosion increases the amount of chlorpyrifos transported into rivers and streams. Chlorpyrifos accumulates in fatty tissue and is not eliminated. The sex chromosome, X, determines the sex of *A. glycines*. Similar to humans, female *A. glycines* are XX, but, males are designated X0, where the 0 indicates the absence of a second X chromosome. Inheritance of chlorpyrifos resistance among *A. glycines* and other target insect species is autosomal and associated with increased production of enzymes involved in the detoxification of harmful molecules.

To determine the mechanism of chlorpyrifos toxicity, you expose 20 *A. glycines* to chlorpyrifos-treated soybean plant leaves and 20 *A. glycines* to untreated soybean plant leaves under standard growth conditions. Within minutes, you observe erratic twitching and the deaths of 19 out of 20 *A. glycines* exposed to chlorpyrifos-treated soybean plant leaves. All *A. glycines* exposed to untreated soybean plants behave normally and none die.

The presence or absence of wings in *A. glycines* males (X0) is determined by one of two alleles for the X-linked gene.

Shortfin mako sharks (*Isurus oxyrinchus*) are the fastest-swimming shark species, at least in short bursts. Scientists have determined that, unlike most fish (including many other shark species), shortfin makos maintain their brain, eyes, digestive system, and swimming muscles at 5-10 °C above seawater temperature, while other body parts are close to ambient temperature.

The tarrkawarra is a small Australian rodent capable of surviving without any free drinking water and produces very concentrated urine. Nursing females produce very concentrated milk and drink the urine of their offspring.

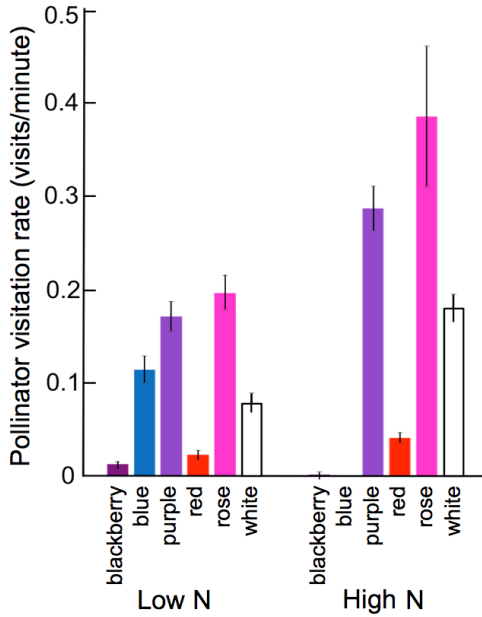


Photo and data courtesy of Dr. Cassie Majetic, University of Notre Dame

Petunias (*Petunia hybrida*) are horticultural plants that exhibit a wide range of genetically determined flower colors (six are listed in the graph) and other traits. Dr. Cassie Majetic and students at the University of Notre Dame conducted outdoor experiments involving petunias, their pollinating insects (which are necessary for petunia reproduction in the wild), and nitrogen (N) fertilizer supply to the petunias during growth. Dr. Majetic and her students also found that increasing N fertilizer led to slightly larger flowers and increased production of the compound eugenol, both of which attract more pollinators. After many generations on an isolated island, a specific pollinator species came to depend solely on petunias for its energy source (sugars in petunia nectar).

Carotene is an orange accessory pigment found in all leaves. Although present with chlorophyll *a*, the peak absorption wavelength of carotene is different.

Estuaries, which are especially vulnerable to eutrophication during the spring or the summer, are saltwater bodies that are less salty (1%) than oceans (3.5%). The toxin secreting *Pfiesteria piscicida*, a species of photosynthetic phytoplankton (algae), lives in these estuaries where fish-kills often occur at night. Fish that ingest *Pfiesteria* toxin have difficulty moving their fins or swimming.

A mouse population in an area of interest totaled to 1,000 mice in year one and exactly one year later it was 1,100 mice in total.

Mike tells Molly (blood type O) that *his* blood type is A.

The St. Lawrence beluga whale lives in a densely populated and highly industrialized region of Canada. In the 1970s, scientists discovered that the species was heavily contaminated with toxic metals (i.e. mercury) and organic compounds like PAHs and PCBs, which led to regulatory changes. Some of these contaminants, which were present in record concentrations in belugas in the 1980s, have since declined. Cancers, which were the main cause of mortality in adults in the 1980s and 90s, have also become less frequent, and no beluga born after 1971 has died from cancer. That being said, populations are still experiencing a 1% decline each year.

Indigenous people in Canada sometimes hunt and consume belugas as part of traditional practices. Despite the fact that prey fish for the beluga in this region are sometimes safe to eat, the consumption of whale here is highly discouraged.

St. Lawrence belugas are a distinct ‘ecotype’ of the white whale *Delphinapterus leucas*. For 10,000 years they have been isolated from ocean belugas, however, when these two different ecotypes are bred in zoos they produce fertile offspring.

About 5,000 St. Lawrence belugas lived in the St. Lawrence Estuary in 1800. It is now estimated that only 900 remain. As such, there are fewer alleles in the St. Lawrence population than oceanic belugas.

Organochlorinated compounds (OC) in high concentrations are found in the blubber of St. Lawrence belugas and are associated with decreased production of antibodies. Scientists found that in 41% of female St. Lawrence belugas, chemicals were impairing transcription during milk production. Because of the high energy demands related to swimming at depth, belugas possess very large specialized mitochondria.

Dr. Maus finds a pair of lemmings that are unusually massive (160g) for their length (150mm) and identifies them as UM1 and UM2. Dr. Maus breeds each with a lemming of normal surface-to-volume proportions (80g; 150mm) as follows:

Parent Cross	UM1 X Normal	UM2 X Normal
Offspring Generation 1	all normal (type 1)	All normal (type 2)
Generation 1 Cross	normal (type 1) X normal (type 1)	normal (type 2) X normal (type 2)
Offspring Generation 2	75% Normal: 25% UM1	75% Normal: 25% UM2
Generation 2 Cross	UM1 X UM1	UM2 X UM2
Generation 2 Offspring	All UM1	All UM2

Dr. Maus is excited by the discovery of new true-breeding phenotypes (UM1 and UM2). Dr. Maus performs a cross of UM1 X UM2 and is shocked to find all their offspring are normal! Dr. Maus turns to Dr. Duc for help. Dr. Duc reminds Dr. Maus that two genes control the leptin system and suggests some physiological testing. Dr. Duc find low leptin levels in UM1 lemmings and high leptin levels in UM2 lemmings. Dr. Duc injects leptin into UM1 and UM2 lemmings. UM1 lemmings lose weight, UM2 lemmings do not.

Dr. Duc measures the water intake and urine output of lemming and finds both much higher than that of a Syrian hamster (a rodent about the same size that lives in a desert environment). When lemmings become dehydrated, one might expect the salt concentration of their blood plasma (the non-cellular liquid fluid) to rise.

While most lemmings fit the typical polygamous mating system pattern for mammals, Evsikov et al. (2006) found that Steppe Lemmings appear monogamous. In other lemming species, females are attracted to and mate preferentially with larger males that are behaviorally dominant over other males in the area.

Lemmings do not hibernate but have brown fat. They spend most of the winter in the burrows or beneath the snow cover searching actively for food. The brown fat aids in thermogenesis (heat generation) because the mitochondria in the cells contain uncoupling proteins (UCPs) which reduce the efficiency of the electron transport chain component of cellular respiration.

The allele for the normal lemming phenotype is 397 codons long. The allele resulting in the UM2 phenotype is TACTAAAGAGTGTC AATTAAACGACTAACT

The intrinsic rate of growth (r) for the populations of lemmings on Trezur Island is 0.2. At the start of the year, the lemming population is 200 when a pair of arctic foxes immigrates to the Island. Dr. Maus estimates the no more than 300 lemmings can remain on the island with the foxes. Dr. Duc checks the fox scat (feces) for lemming DNA to see if they are being eaten.

Male guppies select females that are larger. Larger females produce more eggs/young during each reproductive cycle and are also able to escape predators thus surviving longer.