

BIOL 1114 Exam #3 (Preview) November 14, 2016

Use a #2 pencil to fill in the information on your NCS answer sheet. Put your **O-Key Account Username** in the boxes indicated for **LAST NAME** and darken the appropriate circles. **Write your Name (Last, First)** and “Star” or “NoStar” in the space above the boxes containing your **O-Key Account Username**. Darken the (S) or (N) in the last column of the name circles. Enter the number **1633** and **darken the corresponding circles** in the **first 4 columns** of the “**Student ID.**” Failure to perform this correctly will incur a **-10pt 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	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine	UCA		UAG	UAA	UAA	UAG	UAA
UUG	UCG		UGG	UGG	UGG	UGG	G		
C	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	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		AGA	A			
	AUG	ACG	AAG		AGG	G			
G	GUU	Valine	GCU	Alanine	GAU	Aspartate	GGU	Glycine	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	GGA	A		
	GUG		GCG		GAG	GGG	G		

Important Equations: $r = b - d$ $G = r N$ $G = r N [(K - N) / K]$

The *Aedes aegypticus* mosquito is the vector (carrier) of the insidious Zika virus. Zika was originally discovered in Ugandan monkeys during the 1930s. More recently, these mosquitos have been getting their “blood meals” from people, sometimes with tragic results. Zika viruses are transmitted by mosquitoes that, while sucking up human blood for a rich meal, contaminate their hosts with viruses collected from previous victims. Because pregnant women infected with the Zika virus often give birth to deformed babies, Zika virus is considered a major public health threat.

An outbreak of Zika virus infection recently struck an urban area of Miami, Florida that had a dense human population, many small pools of water ideal for mosquito egg-laying, and no local predators that consumed mosquitoes.

Extensive research is going into producing a vaccine against the Zika virus. You would correctly predict that such a vaccine must include...

Hemoglobin is the oxygen carrying protein in red-blood cells. It is composed of four chains of amino acids (polypeptides) – two of the alpha form and two of the beta form. The amino acid sequence of the beta chain is determined by the HBB gene. It is located from base pair 5,225,466 to 5,227,071 on chromosome 11. A genetic disorder called beta-thalassemia is associated with this gene. Traits for thalassemia are more common in people from Mediterranean countries, Asia, Africa, and the Middle East. There are several different forms, resulting in different degrees of anemia (reduced levels of functioning hemoglobin), from very mild to fatal. The trait is inherited as an autosomal recessive, with one of the mutations affecting the DNA codon GTC at 5226970.

While high frequencies of alpha-thalassemia (which is associated with high mortality rates) in some human populations are considered a result of bottlenecks (founder effect), high frequencies of beta-thalassemia often occur in areas with high infestations of malaria. Malaria is caused by a parasite that, when in humans, lives inside red blood cells for much of its life. Of the 215 million people infected each year between 2-3 million people die, three-quarters of which are children. The malaria parasite, which is a unicellular eukaryote, has been gaining resistance to the drugs used to treat it. On the other hand, efforts to develop a vaccine against malaria have been challenging. Humans appear to develop immunity to malaria only after repeated infections.

A man with no family history of beta-thalassemia (BB) married a symptomless woman (Bb) who had a son with beta-thalassemia by a previous marriage. The daughter (Alena) survived, married a man (Aleksy) with beta-thalassemia, and had a son (Jacobo) with beta-thalassemia. Alena had type A blood and Jacobo (her son) had type O blood. Alena was colorblind. Aleksy, who is not colorblind, is delighted when their daughter Jacobina is born, and helps Alena by picking out all the colors for Jacobina’s room.

Although HIV virus can infect any human being, some infected individuals show no symptoms, but can infect others. Infected people without symptoms lack a receptor in their CD4 lymphocyte membranes. The receptor is coded by a gene (CCR5) located on the third pair of chromosomes in humans, and this receptor normally allows HIV to enter CD4 cells triggering therein metabolic changes with the known devastating consequences. According to some evolutionary studies, changes in 32 base pairs of the CCR5 gene caused the loss of that receptor about 1000 to 2000 years ago. The population lacking this receptor is remarkably small compared with the global population and is restricted to Western Europe (mostly people from Sweden).

After a blood test, Agoston Beckius, who migrated from Sweden to Colombia, was told that his CD4 lymphocytes lack CCR5. Agoston married a Colombian lady and had 6 children. All of them were tested for the CCR5 receptor and all of them including his wife had the receptor. One of the Agoston’s sons married a heterozygous Colombian woman.

One species of flatworm, *Macrostomum hystrix*, is able to mate with other individuals as well as self-fertilize (egg and sperm from the same individual). These worms vary in body length (short vs. long) and color (gray vs. brown). A scientist had four different flatworms as described in the table below in the laboratory and crossed them in many ways to see what offspring would be produced.

Flatworm	Color (gray dominant to brown)	Body length (long dominant to short)	Notes
1	Gray	Short	
2	Brown	Long	If this flatworm self-fertilizes, 100% of offspring have long body lengths.
3	Brown	Short	
4	Gray	Long	If this flatworm self-fertilizes, it produces a 3 gray to 1 brown color ratio.

The streamside salamander (*Ambystoma barbouri*) breeds in cool streams (35 °F) during the winter. Females have generally large clutch sizes, each female laying dozens of eggs under rocks in the stream. Mike is a graduate student studying the population dynamics of this salamander species in streams of middle Tennessee, and has been recording population sizes. Last winter, Mike recorded a population size of 50 salamanders in Marshall County and upon returning to the site before the next breeding season, he found that the population had decreased by 15 salamanders.

Concerned about the status of his Marshall County population of *A. barbouri*, Mike learns that rainfall in the area was abnormally low this past year, and as a result the stream dried completely in late summer.

A. maculatum eggs have a green color because a species of algae grows in the eggs of this salamander species. The eggs produce nitrogen, which helps the algae grow, and the algae provide oxygen for the developing embryos via photosynthesis. Mike collects some *A. maculatum* eggs in a see-through green container to transport them back to the lab.

A mammalogist estimates that there are $N_1 = 10,000$ deer mice (*Peromyscus maniculatus*) living in a large section of forest, which she estimates has a carrying capacity (K) of 100,000. The population appears to have an intrinsic growth rate (r) = 0.05 deer mice / deer mouse / year