BIOL 1114 **Exam #4 (Preview)** **December 10, 2009**

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**" **in the space above the boxes containing your O-Key Account Username**. Darken the **(S)** in the **last column of the name circles**. Enter the number **934** and **darken the corresponding circles** in the **first 3 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.

Use the following formulas and chart as needed.

r = birth rate(b) – death rate(d) **G = rN** **$G = rN\frac{(K - N)}{K}$**

mRNA-Codon-to-Amino-Acid Decoder Chart

		2nd Letter							
1st Letter	U		C		A		G		3rd Letter
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	Arginine	A
	AUG	Methionine; START	ACG		AAG		AGG		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		

Meet the Spider-Lizard: This reptile is not a superhero but accurately displays Spiderman's colors (except when frightened or at night). The Spider-Lizard, a native of Kenya, is properly called the rock agama (*Agama mwanzae*), and males grow up to one foot in length. A balanced diet for a Spider-Lizard may include grass, berries, seeds as well as plant-eating mealworms, locusts and crickets. To impress female Spider-Lizards during courtship, the more colorful male bobs his head vigorously. At least 37 species of agama inhabit various regions of Africa. Spider-Lizards and other agamas are more tolerant of higher temperatures than most other reptiles. When the environmental temperature exceeds 38°C, however, they rapidly burrow or seek shade. When the Spider-Lizard's body temperature exceeds 42°C, its rate of ATP production begins to slow. Male Spider-Lizards typically are about 25% larger than their mates. Newborn hatchlings are about 5% the size of their mothers. Spider-Lizards are gaining popularity as pets, especially among Spiderman fans.

A small, isolated population of spider-lizards in which the males are a brighter red than the average males in the much larger nearby population is discovered by Dr. P. Parker. Like all good scientists, Dr. Parker develops several alternate hypotheses for this. One is that it is the result of the founder effect alone. Another hypothesis is that the brighter coloration is a result of natural selection **not** sexual selection. Dr. Parker also proposes that the bright red color results when nerve cells stimulate pigment

containing cells to change shape and display the pigments they contain. Dr. O. Ctopus, Dr. Parker's research rival, has reviewed historical records and found that as the shells on the seeds that Spider-Lizards ate have become thicker so too have the lizard's teeth and jaw muscles.

Unable to compete with Dr. Parker's almost spider-like ability to unravel the web of knowledge about these lizards, Dr. O. Ctopus switches to a study of obesity in mice. He begins by injecting over-weight mice with leptin and weighing them. They lose weight!
When he crosses his overweight mice with a normal mouse, none were overweight. Dr. O. Ctopus analyzes the gene that causes this form of obesity. He finds that it is composed of 13% **A**denine.

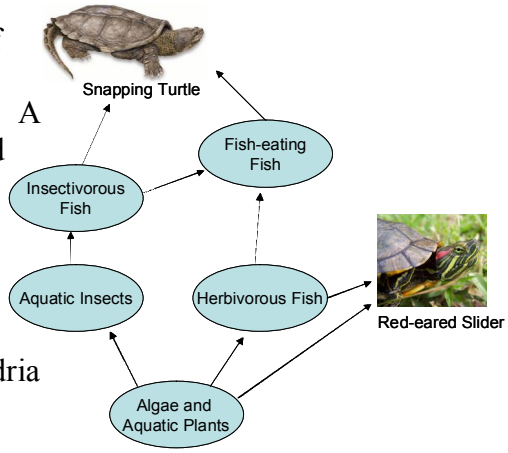
Dr. O. Ctopus cannot contain his jealousy for Dr. Parker and attacks him. Dr. Parker has to go to the hospital for a blood transfusion. He is blood type A.

Unlike human beings, many species of birds possess the ability to detect ultraviolet (UV) light, which consists of electromagnetic energy with wavelengths shorter than visible light. The origin of this ability has been traced to a point mutation (the substitution of one nucleotide base for another) in the rhodopsin gene that for many vertebrates normally codes for a pigment-containing protein that helps them detect dim light. The resulting altered (mutated) gene codes for an altered rhodopsin protein, "UV-rhodopsin".

The ability of some birds to detect UV light enhances their ability to find prey in comparison to birds that only see visible light.

Protein sequencing reveals that the UV-rhodopsin protein has 348 amino acids, the same number of amino acids present in normal rhodopsin protein.

Snapping turtles (*Chelydra serpentina*) are large turtles that consume fish of all sizes including large fish that eat other fish. Red-eared sliders (*Trachemys scripta*) are smaller turtles that eat small fish and plant material. A researcher in Oklahoma is studying a contaminated stream and has proposed the food-web shown above for the stream. The stream is heavily polluted with a variety of chemicals including nitrogen, phosphorous, and methyl-mercury (a chemical that biomagnifies). Part of the stream is polluted with parathion (an insecticide that inhibits acetylcholinesterase in many animals including turtles). Another part of the stream is contaminated by dinitrophenol, a compound that makes the inner membrane of the mitochondria leaky to protons (H^+).

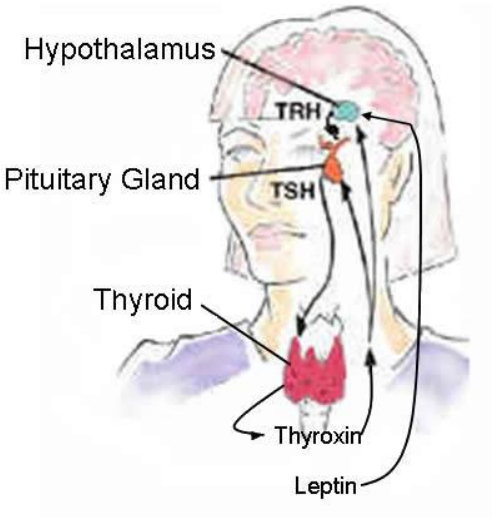


Proposed food web for an Oklahoma Stream

The researcher was interested in how the oxygen concentration in the water changes over a 24 hour period. He measured the oxygen concentration at just before sunset, midnight, just before sunrise, and at noon. The turtle researcher also wanted to investigate the influence of light on the photosynthesis rate of algae. The researcher collected stream water and placed it in 9 clear-glass jars. Three jars were left in the sun (unfiltered sunlight), three were shielded with a filter that removed green light (green-filtered), and three were shielded with a filter that removed blue and red light (red and blue filtered sunlight). In another experiment, the researcher removes algae from unfiltered light and puts them in complete darkness.

Mustang horses are found in environments with a wide range of temperatures. Horse enthusiasts wish to know how mustangs tolerate the range of temperatures. During cold nights, mustangs curl up to stay warm. Mustangs are shorter and more compact than the horses that were originally brought to North America. The short bodies allow them to travel quickly through rough terrain. If a red mustang stallion (RR) crosses with a white mustang mare (rr) they produce, roan (Rr) offspring.

Mustangs often can escape one of their predators (mountain lions) by quickly moving through rough terrain. An alternative hypothesis for why a cougar may not catch a mustang is that the cougar cannot sprint for long because it cannot supply its muscles cells with enough oxygen. Unable to capture a speedy and agile mustang, a mountain lion captures a deer and then marks its territory by urinating on the ground. Before it percolates and diffuses, the urine creates a temporary change in the environment inhabited by the soil's microorganisms - the salt concentration of the urine exceeds the concentration of the cytoplasm in the microorganisms.



Marissa Metts is an active mother of four and an accountant, which requires several hours of sitting at a desk. Marissa has noticed a slight weight gain in the last few months. Marissa decides to visit the doctor to find a solution to her weight gain. The doctor orders some routine tests and he is curious when the results show that Marissa's TSH levels are extremely high, but her thyroxin levels are extremely low. Marissa is diagnosed with hypothyroidism based on her low level of thyroxin production. Other symptoms associated with this disorder lead to weight gain, poor physical health, and increased cholesterol levels. The doctor prescribes Marissa with a pill that contains synthetic thyroid hormone.

Hormone	**Marissa's Results**	**Normal Levels**
TSH	10.0	0.3 – 3.0
Thyroxin	2.9	4.5-12.5

Dr. Andrew Barnabas took fish out of a lake and under controlled conditions measured their oxygen (O_2) consumption across the whole range of temperatures that they can survive. He found that higher water temperatures resulted in higher oxygen consumption.

Zebra mussels have been introduced into Boomer Lake by a fisherman who did not clean his rubber boots. The size of the population at the beginning of the month is N=40 and it is growing exponentially. The birth rate (b) of the population is 3.4 mussels/mussel/month and the death rate (d) is 0.4 mussels/mussel/month.

Adrenoleukodystrophy (ALD) is a rare disorder that causes brain damage and always causes death during childhood. Individuals that have the disorder lack the allele that produces enzymes (a protein) that breaks down fatty acids. The gene for ALD is encoded on the X chromosome.