Preview Material – Exam 1 – Spring 2006

This exact material will appear on the exam, although it may be arranged differently.
You are free to discuss it with others, including the instructors.

Worker bumble bees are often responsible for maintaining the temperature of eggs in response to the ambient temperature of the hive. In a recently published experiment, the activity of worker bumble bees was monitored and recorded. Worker bees either fanned the nest or incubated brood cells with eggs as needed. Incubating the brood cells involved the worker bee coiling her body around the cells and contracting her muscles. The ambient air temperature of the hive was recorded regularly.

When the hive's ambient temperature dropped below 28°C, the vast majority of workers were observed incubating the eggs in the brood cells. When the ambient temperature rose above 28°C, the vast majority of the workers were observed fanning the nest. To test the cause of these observations in the lab, Dr. Mel Ifera incubates eggs at 22°C, 34°C or 28°C and measures the rate of enzyme activity in each group of eggs.

Plants have been producing toxic compounds long before agrochemical companies got into the business. One group of compounds commonly found in plants is cyanogenic glycosides. Cyanogenic glycosides are compounds composed of a sugar combined with the toxin cyanide. Passion vine and the human foods, cassava, almonds, yams, and lima beans, all contain cyanogenic glycosides (one good excuse not to eat lima beans). When plant cells that contain these compounds are chewed by insects, an enzyme is activated that releases poisonous hydrogen cyanide from the glycoside and the insect dies hungry. Hydrogen cyanide binds to an electron carrier in the Electron Transport Chain and blocks electron flow.

Passion vine is the sole food source for the butterfly, *Heliconius sara*. Female butterflies lay their eggs on the plant and the emerging caterpillars have a voracious appetite for the passion vine. Normally the cyanogenic glycosides being a poison stops feeding insects from eating the vine, but *Heliconius sara* can detoxify cyanogenic glycosides and disarm this plant defense. Some species of passion vine have also developed hooked hairs that they use to impale and kill the toxin-disarming caterpillars.

You are interested in how much passion vine must another species of caterpillars consume before they stop eating and die. You set up the following experiment. For each different quantity of passion vine per caterpillar there are five jars. In addition to the passion vine, each jar contains a quantity of a nonpoisonous food source so that the total amount of food equals what 10 average caterpillars eat in an eight hour period. Each jar has 10 caterpillars of the same sex obtained from a single group of recently hatched eggs. The jars are incubated at the same temperature in a well-lit room and the following results are obtained.

Quantity of passion vine per caterpillar (mg)	Number of deaths
1	2
5	5
10	7
15	10
0	0

After a hard evening of study the night before the first BIOL1114 test of Spring Semester, a student decided to walk over to the Colvin Center and spend some time relaxing in a hot sauna before the center closed for the night. While in the sauna, some pranksters took his clothes and left him with only the swim trunks he was wearing. On coming out of the hot sauna and discovering his predicament, he thought a late night stroll (walk) back to his dorm in early February (35°F) might be invigorating while clearing his mind for the upcoming test. Without further thought, he stepped out of the sauna and began his adventure. Once outside and making his way to the dorm, a slight breeze came up and he felt cooler. As he approached the dorm he noticed that he was beginning to shiver.

After scoring 100% on the exam the next day, the student decided to make this an annual event on the same night. The next year, having put on 30 pounds from diligently working out at the Colvin Center, he noticed that he did not get as cold on an identical night following the same routine.

Bird-pollinated flowers are typically brightly colored. They produce copious amounts of nectar at the bottom of elongated, tubular flowers. The nectar contains a high concentration of glucose. Birds that pollinate flowers have good color vision and long bills to reach the nectar.

You measured CO_2 released from two groups of flowers and birds. One group is kept in the dark at 25°C. The other group is kept in the dark at 41°C. The birds released the same amount of CO_2 under the two temperatures while the flower released less CO_2 at the lower temperature than at the higher temperature.

Penguins, which like all birds are homeotherms, inhabit the southern hemisphere and can be found in tropical areas or desert islands as far north as the equator. Emperor penguins, the largest penguin species, are one of two species that live their entire lives on Antarctica. Their closest relative, the king penguin, lives further north in subantarctic (warmer) climate, and has a body shape very similar to the Emperor Penguin. All penguins face the problem of having well insulated bodies, but poorly insulated flippers, which allow them to swim by "flying" through extremely cold waters. Emperor penguins face the additional challenge of breeding in the Antarctic winter, which entails long periods of fasting by the incubating parent while the other parent travels many kilometers to the sea to feed and bring back food for the chicks. Emperor penguins have been made famous in movies for their journey to the sea and their behavior of incubating their chicks by allowing the chicks to sit on a parent's feet and covering them with their bodies. The Emperor Penguins have a specialized arrangement of feathers on their feet to help them keep their chicks warm.

Because they are fasting for approximately 120 days while protecting their eggs and chicks, adult Emperor penguins must reduce their metabolism. They must also keep warm in the frigid Antarctic winter. A single penguin cannot do this, but a flock can.

Penguin skin is relatively impermeable to salt water, however, like our own, some water can pass through, but salts and other ions cannot.

Dr. Mondavi works at a winery and is interested in developing a new recipe for growing yeast. Normally, in the process Dr. Mondavi uses, the yeast are provided glucose as an energy source. Dr. Mondavi decides to test whether pyruvate will serve equally well as a carbon and energy source. Dr. Mondavi takes two flasks, fills them each with equal volumes of warm water and adds yeast. To one flask Dr. Mondavi adds a quantity of pyruvate. Dr. Mondavi incubates the yeast at 35°C for 30 minutes, and then measures the gas that is released over a five minute period from each yeast solution.