Preview Material for Exam 4 Fall 2005

In a large inlet near the Arctic Circle in Scandinavia is a small group of barren islands. Because of changing weather patterns, and a serious storm, seeds from some flowering plants were blown onto the island where no other flowering plants had been before. At the same time a few of the small beetles that pollinate the flower were also blown to the island. From this initial population, a series of populations of these flowers began to grow on the island over many, many generations. Those that grew closer to the seashore became increasingly more tolerant of the salty conditions and grew shorter, tougher leaves. Those that grew at the higher elevations were shorter but produced darker leaves that absorbed more heat. Another form of the plant grew on the portion of the island shaded by rock formations and these flowers grew taller and produced broader leaves. Several other uniquely adapted populations also arose on the island. Although all of the populations had the same color flowers, the blooming of each population occurred in one of a series of two-week periods; no population bloomed at the same time as another.

The beetles that pollinated each population of flowers synchronized their breeding so that each population mated and laid eggs right after the flowers bloomed. The eggs overwintered at the base of these plants and they completed their metamorphosis just as the flowers were blooming. The beetle larvae ate a moss that grew on the island. To attract females, the males performed a ritual courtship dance on the petals of the flowers that they pollinated. The males that danced most vigorously first thing in the morning attracted the most mates. Research has shown that males, that were able to produce a particular enzyme, metabolized glucose faster and at a higher rate when the ambient temperature was low. This resulted in these males being able to move faster earlier in the day. After mating, the females crawled to the base of the plant, laid about 100 eggs and died. Their bodies provided nutrients for the mosses on which their young fed. Males continued to dance on the flower until it withered, then the male carried pollen to the next flower and began dancing to attract another mate.

Dinoflagellates are abundant unicellular algae found in both marine (saltwater) and freshwater ecosystems. There are several thousand species of dinoflagellates and each has a characteristic shape that in many species is reinforced by internal plates of cellulose. Cellulose is assembled by linking together glucose molecules.

Dinoflagellate blooms – episodes of exponential growth – can result in a phenomenon called "red tide" in coastal waters. The blooms appear golden or red because carotenoids are the most common pigment (various shades of orange and yellow) found in dinoflagellates. When this happens, many kinds of marine life suffer because some species of dinoflagellates produce neurotoxins. Brevetoxin results in Neurotoxic Shellfish Poisoning and Saxitoxin results in Paralytic Shellfish Poisoning. Red tides are often accompanied by mass mortalities in fish, invertebrates, birds, and mammals. Humans may also be affected by eating fish or shellfish (oysters, mussels, clams) containing the toxins; however, most cases are not fatal.

Large amounts of nitrogen may be carried great distances away from the places where the nitrogen enters the water. Red tides often occur just offshore (in shallow sea water at the edges of continents) when rivers carry nitrogen-rich fresh water down to the edge of a continent, for example, along the Gulf Coast of the US.

Springtails are very small (1-2 mm long) insects named for their ability, when disturbed, to spring up into the air a distance of 4 or 5 times their length. They feed on algae and fungi including mold. They live in decaying leaves, rotting logs, and in damp and moldy places in houses. Holly is a biologist who moved into an old house where water seeped into the basement after heavy rains. In the basement previous residents left an old sofa, which was covered with jumping springtails. She wondered whether the springtails could eat all of the mold off the sofa covering if she left the sofa in the cool basement or whether she would have to move it to a warmer place. She began with a preliminary experiment. She cut out four 625-sq cm pieces of the sofa cover, placed each in a small aquarium with a small-mesh lid and sprayed the pieces of sofa cover with a fine mist of water every day. She kept one aquarium at 15 ^{O}C, one at 20 ^{O}C, one at 25 ^{O}C and one at 30 ^{O}C. She placed 25 springtails in each aquarium. At the end of 4 weeks, she measured the area of mold each group had eaten.

Temperature ^{O}C	15	20	25	30
Sq. cm mold eaten	145	150	246	298
Spring distance (cm)	1.8	3.3	5.4	8.1

Dr. Pidley at BSU notices that one of the mice in her lab is much heavier than the rest. She notices that he eats more and that all of the female mice spend a lot more time with this mouse than all of the other males. She has read about the research on leptin and decides to do some investigating as to whether the cause of this animal's condition is related to the leptin hormonal pathway.

Dr. Pidley establishes a mating cross and waits to see what offspring result from the mating of the large mouse and all of the normal looking females. The offspring (Generation F_1) were all normal looking and when they matured, they started breeding among themselves and produced the following offspring:

(Generation F_2)

	Normal	Large
Male	186	62
Female	186	58

Dr. Pidley names the large phenotype, Bulbous, and the mouse himself, Mr. Big.

Dr. Pidley returns to the question of the cause of the affliction and decides to measure the leptin levels in the bloodstream of Mr. Big and a Normal mouse. She finds that Mr. Big's level was 20 $\mu g/l$ and the Normal mouse's was 1 $\mu g/l$.

In horses, leptin (controlled by an **autosomal recessive allele**) functions to regulate fat just as it does in mice. A horse named George was quite fat. George's owner injected George with leptin, hoping the horse would lose weight, but George just continued to overeat and gain weight. George was bred several times to a mare named Martha. All their offspring grew normally and their weights were within normal range by the time they were adults. When these offspring (F_1) of George and Martha were bred, most of their foals were of normal weight. However, one named Vernon, gained weight rapidly and became fat like his grandsire George.

The paralysis ticks rear their ugly heads once more:
Our Australian rancher is really interested in population growth and before establishing her own ranch she worked for 3 years at a large cattle ranch in Australia. The owner put her in charge of a herd of cattle that contained 80 cows and 4 bulls. This herd was maintained on 2500 acres of pastureland. During her time there she collected the following data on the cattle herd:

Year	Births	Deaths
1	90	6
2	180	20
3	200	28