Preview Material for Exam 1
Fall 2002

Pogonomyrmex occidentalis, the western harvester ant, is common in the western United States where it is found even at cool and dry elevations above 5,000 feet. These ants live in colonies and build cone-shaped mounds that stand about 20 inches (50 cm) tall. The mounds have elliptical (oval) bases. The ants clear most of the vegetation from around the mounds for about 3-6 feet in all directions so that the mounds are not shaded. The colony's tunnels extend nearly 9 feet (2.7 meters) below the soil surface and connect various chambers. Because ants are poikilothermic, temperature of the mound is critical to activity levels of adults and developmental rates of juvenile ants. Several factors influence mound temperature. Externally, sunlight and air temperature will alter the temperature inside the mound. Internally, metabolic activity of bacteria decomposing waste material inside the mound and metabolic activity of the ants themselves will warm the mound. In many species of ants and termites, thermoregulation appears to be an important function of mound geometry and the asymmetrical shape of this species' mounds has led researchers to suspect the same for P. occidentalis.

In a recent study to examine whether P. occidentalis shapes its mounds to catch the morning sun and thus aid in thermoregulation, a researcher recorded subsoil temperatures on all 4 sides of the mound as well as 2 off-mound temperatures. This was accomplished by inserting the tip of a digital thermometer 1.6 inches (4 cm) into the mound on each of the 4 cardinal sides (E, W, N, S) at a distance of 4 inches (10 cm) from the apex (top) of the mound. The off-mound temperatures (at 4 cm depth) were recorded in sunlit, bare soil and then in a shaded area. Temperatures were recorded at two different times during the day (morning - when the sun was up and afternoon when the sun was going down) and on three different days during the summer. The investigator also measured the grade/steepness of each side of the mound. A less steep slope would expose more surface area to the sun and thus absorb more radiant energy during each day.

Brady Brine lives on the Gulf of Mexico coast, and is a lifelong saltwater fisherman. Although he is very knowledgeable about ocean fishing, Brady has led a sheltered life and has little education or experience beyond his small town. While vacationing in the western U.S., Brady pulls off the road in his RV, and takes out his favorite fishing rod to try fishing in Great Salt Lake (GSL), Utah. He figures that any lake with the word "salt" in it must be just like the ocean, so he daydreams of grilling some fresh-caught flounder for dinner. Earlier, he had stopped by "Bubba's Bait-n-Tackle" shop near a (freshwater) stream to pick up some minnows for bait. Not wanting to brag about his fishing skills, Brady didn't tell the owner where he planned to fish. Too bad, because Bubba would have told him that his fishing efforts would be futile. GSL is about 25-30% salt (mostly NaCl, close to saturation), compared to only 3.5% in the oceans, so salty that only a few specially-adapted species of bacteria, algae and brine shrimp can survive.

On the way home to Louisiana, Brady stops at the Great Salt Plains Lake in western Oklahoma. This time he talks to the locals, who tell him that the fishing really is good in the lake. He learns that the salinity of the lake is only about 0.4% (less salty than fish cells), and the fish are typical freshwater species. He tries an experiment in which he mixes varying proportions of water from GSL (which he collected as a souvenir) and the Great Salt Plains Lake to make different salinities, and checks survival of freshwater minnows in each mixture.

Seeds of plums, apricots, cherries, peaches and almonds contain a substance called amygdalin. Amygdalin is responsible for the familiar taste and scent of bitter almonds. Chemically it is a cyanogenic glycoside that can produce hydrogen cyanide (HCN, a secondary metabolite) whenever plant tissue containing it is crushed or damaged. Also, HCN molecules are released when the seeds are digested. The production of HCN from amygdalin is facilitated by enzyme activity. In intact tissue, the amygdalin and the enzyme reside in different compartments; therefore, no reaction occurs in the plant. When the tissue is damaged or digested by an animal, the walls of the compartments are destroyed, allowing the enzyme to bind with amygdalin and release HCN. In an animal, HCN molecules disrupt the metabolic activity of the mitochondria because they stop the electron transport.

An entomologist interested in the life history of a particular moth species has been collecting data on the feeding habits of the caterpillar stage (the immature or juvenile). After closer examination, she notices that the caterpillars spin silk over the surfaces of the leaves on which they feed. On closer inspection, she notices that the caterpillars use the silk to protect themselves from the trichomes (tiny, hooked, sharp, plant hairs that puncture and kill insects) found on these leaves. Curious about her observations, she looked back in her notes. She found that 20 years ago the caterpillars in her lab did not spin silk over the leaves as they walked. Then she went to the library and read that other scientists had observed this type of caterpillar eating such leaves 100 years ago, but they did not report the caterpillars spinning silk over the leaves. She then checked leaf samples in the herbarium and discovered that 50 years ago, these plants did not possess as many trichomes. "Eureka", she remarks, "I have proven that coevolution has occurred in these two species."