Biology 1114
Preview Material – Exam 2 Fall '02

In the Sonoran Desert of Mexico, Dr. Ted Fleming recently made some observations concerning the relationship between a species of moth (Senita moth) and a cactus species (Senita cactus). The cactus blooms (flowers) during the spring and summer only. At this time, successive generations of Senita moths pollinate the cactus flowers as they move from flower to flower feeding on the nectar contained in the flowers. They also lay their eggs on the flower at this time. Once a flower is pollinated it will produce marble-sized red fruit, some of which is eaten by the Senita moth larvae (hatched eggs). These larvae will form pupae that hatch as adult moths. The larvae that come from eggs late in the summer do not have time to pupate and mature into adult moths because the cactus stops fruiting. Therefore they bore into the cactus branches and wait for spring when the weather is warmer and there is more food available. The Senita cactus blooms are open only at night, when moths are active. When the weather starts to cool at the end of summer, bees that feed early in the day may find flowers still open. But in warmer weather, at the height of the blooming season, alas, all the drinking establishments (i.e., flowers) close at dawn. Thus pollination is totally dependent on the Senita moth.

In 1883, Thomas Englemann used a prism to project the full spectrum of visible light along the length of a filamentous (resembles a strand of hair) green alga (singular of algae) that contains chlorophyll a and b. This experimental set-up exposed sections of the alga to different wavelengths of light (ranging from violet through red). He then placed aerobic bacteria in the container with the alga. These bacteria require oxygen and accumulated in the areas with higher oxygen concentration. This allowed Englemann to determine which sections of the alga were producing the most oxygen and thus which wavelengths of light resulted in the highest rate of photosynthesis.

A scientist observes that about 95% of the individual grasshoppers of a particular species are green, similar to the plants that they live on. He hypothesizes that these grasshoppers are green because they are harder for visual predators to detect against the green background of plants. To test this hypothesis, the scientist conducts an experiment. He marks 100 green grasshoppers with spots of red nail polish, another 100 green grasshoppers with transparent (colorless) nail polish, and a third 100 green grasshoppers are left unmarked. Twenty-five (25) of each type are placed in each of 4 field plots in different locations, which are videotaped over the course of a day to document predation (without the presence of the scientist to influence predator behavior). This whole experiment is repeated on 3 days and the results compared. He predicts that, if the hypothesis is correct, natural predators such as birds and praying mantises (which are also green insects) will capture more of the red-spotted grasshoppers than the control grasshoppers. He combines results (below) for all 4 plots and 3 days, after determining that there were no statistical differences between days or plots.

Grasshopper group	Percent captured by birds	Percent captured by praying mantises
Red nail polish	42	14
Transparent nail polish	16	13
Unmarked	15	17

Sea slugs (snails without shells) inhabit various marine (ocean) communities. Their gills (gas-exchange organs) are fingerlike projections on their dorsal side (back). Elysia spp. (sea slugs) live on well-lit coral reefs and eat certain green seaweeds (algae). Rather than completely digesting the algae, their digestive tract cells engulf (phagocytize) the chloroplasts and temporarily store them intact and fully functional in their gills, while digesting the rest of the algae. The sea slugs thus have a green color similar to the algae they crawl over and eat. Similarly, many corals (primitive invertebrate animals) contain symbiotic (living inside) intact single-celled algae, rather than just their chloroplasts. Since it is possible for photosynthesis and respiration to occur simultaneously, only the net release or consumption of CO2 and O2 by the slug/chloroplasts or coral/algae pairs can be measured easily.

Soapberry bugs are found in the southern U.S. including Oklahoma. They feed only on plants in the family Sapindaceae by inserting their piercing mouthparts into the fruits and sucking the contents of the seeds. The lengths of the "beaks" of these bugs reflect the size of the fruits on which they feed. Those populations that feed on big fruits tend to have long beaks; those feeding on smaller fruits have short beaks. Equally important, is the observation that soapberry bugs mate and lay their eggs only on the fruit they eat. In the 1950's, horticulturalists brought three new species of Sapindaceae plants into the U.S. and soapberry bugs began to feed on them. Since the introduced plant species had much small fruits than the native plant species, Scott Caroll and Christin Boyd studied the changes that occurred in beak lengths of soapberry bugs. They found that over time, those bugs living on the introduced plants (smaller fruits) had shorter beaks than those living on native plants (larger fruits).