

Preview Material – Final Exam – Fall 2003

Pitcher plants are carnivorous plants that capture food by the pitfall method. Specialized leaves form a pit (the pitcher) which fills with rainwater and digestive enzymes that are produced by the plant itself. Tropical pitcher plants belong to the genus *Nepenthes*. Insects and other small animals are attracted to the plant by color, odor, and nectar. The nectar is strategically located so that animals must land on the pitcher in order to obtain the nectar. The rim and upper sides of the pitcher are covered by a slippery substance that helps capture unwary prey that land on the surface. Downward pointing hairs make it difficult for visitors to escape the pit once they have fallen in. The prey drown in the fluid and are digested (decomposed). As their bodies decompose, nutrients are made available to the plant.

Although ants make up a large portion of the diet of some pitcher plants, those ants in the genus *Colobopsis* have a special relationship with *Nepenthes* in Borneo. These ants make their nests in the hollow portion of the plant under the pitcher and obtain nutrients and energy from the plant's nectar. They climb up and dive into the plant's digestive juices and paddle about, patrolling the liquid trap where they collect large (cricket-size) prey items. Several adult ants haul the insect up out of the pitcher for a communal feast. This benefits the plant because when large prey items pile up in the pitcher and start to decompose, the juices turn foul and then the plant is unable to digest anything (plant indigestion). It is thought that the ants are protected from digestion because their tissues contain enzymes that block/disable the digestive juices.

The evolution of carnivorous plants is thought to be the result of a lack of nutrients in soil. All *Nepenthes* grow in extreme habitats of nutrient-poor soil, and by capturing their own food they obtain essential nutrients.

The skunk cabbage (*Symplocarpus foetidus*) is a plant capable of generating heat through the activity of the electron transport chain in mitochondria. During aerobic cellular respiration, most energy released from glucose is eventually used to convert ADP to ATP, but when heat is needed, most energy from glucose dissipates as heat without ATP formation. On a cold day the temperature of the plant may be 15-20°C above the environmental air temperature. The skunk cabbage can grow up through a thin layer of ice by melting it very early in spring. The high temperature of the flower releases compounds that have a skunk-like odor, attracting certain insects that pollinate the plant.

Rocky Mountain Spotted Fever (RMSF) is a bacterial disease of humans and dogs that is transmitted by ticks. The tick species that transmit the bacterium feed on a variety of mammals --- rodents, rabbits, dogs, deer, cattle and humans. The first reports of RMSF were in the western United States, where, with increased

deforestation of land for agricultural use, the number of cases has decreased over time. Oklahoma now has more cases of RMSF than many other states in the US. With declining cattle markets and a reduction in the number of farms, cleared land is reverting back to oak hickory type forests, an ideal habitat for deer, rodents and ticks.

A scientist interested in ticks attempts to breed individuals of *Ixodes ricinus* and *Ixodes dammini* both within and between groups. To make breeding groups, he places equal numbers of each type in jars as follows:

	Jar 1	Jar 2	Jar 3	Jar 4
Contents:	<i>Ixodes ricinus</i> males and females	<i>Ixodes dammini</i> males and females	<i>Ixodes ricinus</i> males and <i>Ixodes dammini</i> females	<i>Ixodes dammini</i> males and <i>Ixodes ricinus</i> females

The plant *Azadirachta indica*, known by the common name, "neem" is native to Asia. The usefulness of the tree was recognized in India and China 4,000 years ago. Leaves and oil from the plant are still used by farmers as a very effective insecticide and insect feeding deterrent especially in stored grains. About 40 years ago the compound azadirachtin was identified as the most potent active compound in the plant. In 1985 a process to extract this substance and stabilize it was patented. This formulation is widely used all over the world by farmers today.

A scientist kept track of a population of insects in one section of the grain storage bin. At the beginning of the first year, population size (N) was 100 insects.

Fruitflies spend much of their time eating and in social interactions, including mating. These activities usually take place near food. In contrast, the flies rest away from food and become mostly immobile and unresponsive to stimuli, very much as we do when we sleep. The autosomal dominant "timeless" allele (**T**) in fruitflies results in flies resting for more than 2 hrs a day, typically at the same times each day. Flies that are **homozygous for the recessive allele (t) are more easily disturbed** during rest, and their rest periods are shorter and spread out over more of the 24-hr day.

One hundred flies from the original wild population under study were placed in a shipping container and sent to a biologist in Japan. Unfortunately, the plane crashed and the fly container broke open on an island in the Pacific Ocean. This founding population of flies found good fruits to feed on and suitable places to rest on the island. However, a species of dragonfly, a carnivorous insect already living on the

island, became a predator of the marooned fruitflies. Many of the flies with the timeless allele (T) were eaten by the predator, which sneaks up on them when they are resting.

Dogs, like people, sleep. Some dogs fall asleep in the middle of activities, as do some humans. This condition is called narcolepsy. In most Labrador retrievers (Labs), a **dominant autosomal allele (A for awake)** results in formation (synthesis) of a polypeptide (protein) that is stored in axon bulb vesicles of neurons in the brain. When the protein is released into the synapse, it results in a postsynaptic action potential in neurons. The firing of the neurons keeps the dog alert except when it is really tired and ready to sleep. Dogs with the **dominant allele do not fall asleep** at inappropriate times. Some Labs, however have **narcolepsy caused by the recessive allele (a)** which results in an abnormal protein produced in the brain.

A kennel owner who bred and trained Labs received a puppy named Terri. Terri fell asleep when her owner took her hunting instead of retrieving ducks that had been shot. Terri became unexpectedly pregnant while her owner was on vacation and she produced a litter of 10 puppies. As Terri's puppies became adults, the owner discovered that four (4) of them also fell asleep in the middle of duck hunting like their mother. Other puppies in the same litter with the narcoleptic puppies had no trouble staying awake.

"Cat dancing" disease is an illness seen in Minamata, Japan near an industry that dumped mercury into the bay. Symptoms (confusion, lack of coordination) were first observed in cat populations of the villages around the bay. Later, symptoms appeared in people that ate fish caught from the bay. Investigators discovered methyl mercury, a toxic heavy metal, in the tissues of different species in the bay. Higher concentrations of the toxin occurred in the carnivores feeding on fish.

A scientist discovers a new mutant mouse that he calls Chunky because they are 80% heavier than normal mice. He wonders about the cause of their excess weight and draws blood from some of the Chunky mice and some normal mice and tests for the presence of Leptin.