

## Preview Material for Exam 4 - Spring 2004

People who live in coastal regions are familiar with a phenomenon called "Red Tide". They may arrive at the beach one morning to find thousands of dead fish and carnivorous aquatic mammals such as dolphins, and they may experience a "choking" feeling as they breathe the air. Red tides are caused by sudden blooms of several species of marine algae (single celled photosynthetic organisms called dinoflagellates containing red pigments). Algal populations during a bloom are so large (several million cells in each liter of sea water) that the water appears red from the shore or from the air. Fish are killed extensively during red tides because these dinoflagellates produce neurotoxins, such as saxitoxin. Depending upon the population densities of dinoflagellates during a bloom, fish exposed to lethal levels will die quickly, while others exposed to sub-lethal concentrations may accumulate the toxins in their bodies. Marine molluscs such as clams and oysters are not as affected by the neurotoxins themselves, but accumulate high concentrations in soft tissues. Humans who eat molluscs containing high concentrations of saxitoxin suffer from paralytic shellfish poisoning and present the following symptoms: numbness in face and neck followed by respiratory difficulty, loss of coordination and death from respiratory failure.

The following data might have been collected by a biologist studying red tide by taking daily samples of seawater in 1 liter bottles.

Day	cells/liter(in thousands)
1	100
2	200
3	500
4	1200
5	2500
6	3000
7	3300
8	3200
9	2800

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In pea plants, the allele for red flowers is dominant over the allele for white flowers. When homozygous red-flowered snapdragons are crossed with homozygous white-flowered snapdragons, all the offspring have pink flowers.

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Scientists discover yet another overweight mouse that they name chunky. When they breed a chunky mouse with a homozygous normal mouse (i.e. a chunky X normal cross), the offspring are all normal. Analysis of circulating hormones in the blood of the mice results in the following summary data.

	Normal Mouse	Chunky Mouse
Leptin Level	Normal	Higher than Normal
Weight	Normal	Higher than Normal

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Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. According to the World Health Organization (WHO), a total of 8,098 people worldwide became sick with SARS during the 2003 outbreak. (Source: CDC factsheet: <http://www.cdc.gov/ncidod/sars/factsheet.htm>)

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Another major use of cholinesterase inhibitors is for treatment of myasthenia gravis, an autoimmune disease in which antibodies are formed against the acetylcholine receptor at the neuromuscular junction. The antibodies bind to acetylcholine receptors to cause a profound muscle weakness and paralysis. Cholinesterase inhibitors can alleviate the symptoms of myasthenia by increasing muscle strength and endurance.

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In the current film "Kill Bill vol. 2," Elle places a deadly Black Mamba snake into a suitcase full of money she is giving to Bud. She has no intention of actually giving the money to Bud because upon opening the suitcase, he is bitten twice in the face by the snake. As he falls to the floor and is gasping for air, Elle calmly lights a cigarette and tells him about the life cycle of the Black Mamba and the effects of its deadly neurotoxin, which causes paralysis. These are the last words Bud ever hears...

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Some insects survive the winter months by allowing themselves to freeze at temperatures just below 0°C (-1 to -3°C). By allowing most of the fluid around their cells to freeze, insects protect their cells with an insulating layer of ice. However, water won't become ice on its own. There have to be proteins that attach to water molecules allowing the water to easily form an ice crystal structure. Because only water molecules can join the growing ice crystals, solute builds up in the remaining unfrozen fluid surrounding the cells. The insects promote the growth of protective ice crystals by increasing the production and concentrations of proteins that help water molecules form an ice crystal structure. Interestingly, the insect does not produce all of these proteins on its own; bacteria that live in the gut of the insect produce some of the proteins. While many species of bacteria are found on the plants the insect eats, only three types produce these proteins and survive in the insects' guts.

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To achieve movement, an insect's body temperature must be above 28°C. The Rain Beetle, which is an insect that lives along the coast of northern California, can remain active year round, despite winter temperatures that regularly hover above 0°C. In fact, Rain Beetles achieve body temperatures of 38°C even when the ambient temperature is near freezing! It turns out that the muscles these insects use for flying (called "flight muscles") are very inefficient and generate large amounts of heat as a byproduct of inefficient cellular respiration. To raise their body temperature enough so that they can fly, the beetles rapidly flex their flight muscles to generate the required heat.

Unfortunately for the Rain Beetle, its flight muscles produce large amounts of heat year round. Overheating can become a problem during warm summer months. Fortunately, as the beetle flies, the rush of air created by the beating wings keeps the beetle from overheating.

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Sockeye salmon provide an excellent example of the life history of many anadromous fish. Anadromous fish live out most of their lives in ocean waters, but swim up rivers and small streams to spawn (mate and lay eggs). Adult salmon die after spawning; they do not return to the ocean. Thus, sockeye salmon both begin and end their lives in cool, gravel-bottom rocky streams, but spend several intervening years in the open ocean. Here are some interesting aspects of sockeye salmon life history:

- The internal body fluids of salmon are **hypertonic** (have a greater concentration of salts) relative to the mountain streams where they spawn, but **hypotonic** (have a lower concentration of salts) relative to ocean water.
- As adult fish in the open ocean, salmon (secondary consumers) feed on smaller fish (primary consumers) that feed on photosynthetic plankton.
- In addition to structural changes in their bodies, male salmon change color from mostly gray to brilliant red and green in preparation for spawning. The bright colors may be useful in displays to attract mates or ward off competitors, but they also make the males very conspicuous to predators such as bears that feed heavily on spawning salmon.
- After depositing and fertilizing billions of eggs, all the adult salmon die. Those that aren't eaten by bears or other predators are decomposed by bacteria in the water. The masses of rotting fish and actively respiring bacteria cause a short-term reduction in dissolved oxygen in salmon streams toward the end of the spawning season.

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From March through May, millions of songbirds migrate back to breeding grounds in the United States and Canada from wintering grounds in Mexico and Central America. Many of these birds will take off at night from the Yucatan Peninsula and fly several hundred miles non-stop across the Gulf of Mexico where they will arrive off the coast of Texas or Louisiana, often exhausted and emaciated, sometime in the late morning or afternoon the next day. Many birds do not make it: they could be taken by predators, go off-course and drown in the ocean, meet a head wind and be blown back out to sea, or simply not have laid down enough fat prior to their departure to fuel their entire journey. Most birds are remarkably adept at navigating (flying in the correct direction) across the Gulf and judging whether or not they are physically strong (that is, fat) enough to attempt the flight. The stakes are high; any birds that get these things wrong will die.