BIOLOGY IN ENGLISH

Terrestrial vertebrates variously maintain the water-salt balance

Desert mammals, such as the kangaroo rat, and seabirds, such as a seagull, illustrate different strategies for dealing with extreme terrestrial environments.

KANGAROO RAT, LIFE IN THE DESERT

Dehydration threatens all terrestrial animals, especially those that live in an extremely dry environment like the desert, as does the kangaroo rat. Its fur prevents loss of water to the air and during the day, it remains in a cool burrow. In addition, the kangaroo rat's nasal passage has a highly convoluted mucous membrane surface that captures condensed water from exhaled air. In mammals exhaled air is usually full of moisture, which is why you can see it on cold winter mornings: the moisture in exhaled air is condensing.

As we shall see, humans mainly conserve water by producing urine that is hypertonic to blood plasma. The kangaroo rat forms a very concentrated urine, twenty times more concentrated than its blood plasma. Also, its fecal material is almost completely dry.

Most terrestrial animals need to drink water occasionally to make up for the water lost from the skin and respiratory passages, and through urination. However, the kangaroo rat is so adapted to conserving water that it can survive by using metabolic water derived from cellular respiration. The kangaroo rat can survive without drinking water (**figure 1**). The adaptations of the kangaroo rat allow it to remain in water-salt balance, even under harsh desert conditions.

SEAGULLS, REPTILES, AND MAMMALS

Birds, reptiles and mammals evolved on land and their kidneys are especially good at conserving water. However, some animals have become secondarily adapted to living near or in the sea. They drink sea water and still manage to survive. If we humans drink sea water, we lose more water than we take in just ridding the body of all that salt. Little is known about how whales manage to get rid of extra salt, but we know that their kidneys are enormous. Other animals have been studied and we have learned that seabirds and reptiles have **salt glands** that pump out salt (**figure 2**). In the two types of animals we will mention, each has commandeered a gland meant for another purpose and used it to pump out the salt from blood plasma and leave behind the water, just as in a desalination plant.

In birds, salt-excreting glands are located near the eyes. These glands produce a salty solution that is excreted through the nostrils and moves down grooves on their beaks until it drips off. In marine turtles, the salt gland is a modified tear (lacrimal) gland and in sea snakes, a salivary sublingual gland beneath the tongue gets rid of excess salt. The work of the gland is regulated by the nervous system. *Osmoreceptors*, perhaps located near the heart, are thought to stimulate the brain, which then orders the gland to excrete salt until the salt concentration in the blood decreases to a tolerable level.

ANSWER

Is the tonicity of the urine produced by a seagull greater than that produced by a human? Why?

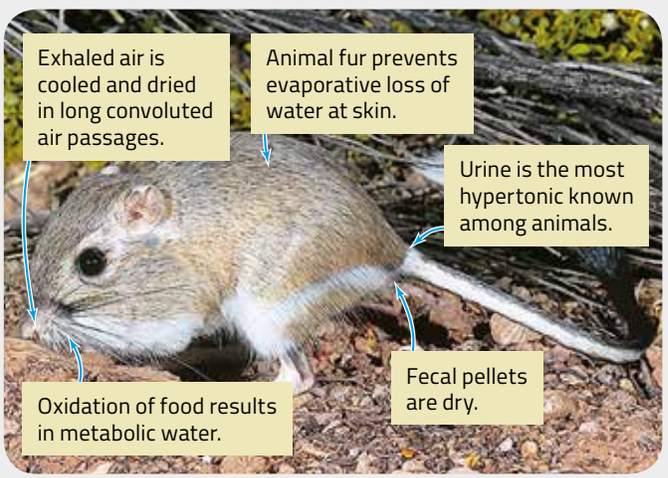

Figure 1 Adaptations of a kangaroo rat to minimize water loss.

Figure 2 Marine birds and reptiles are apt to have salt gland to pump excess salt.