

Blood, sweat, and tears



Living without water
Kangaroo rats such as *Dipodomys spectabilis*, a denizen of the Arizona desert, may never see free water during their lifetime. Their dry-adapted excretory systems allow these rodents to derive enough water to survive on from their food.

Blood, sweat, and tears taste salty because they have similar ionic concentrations as the interstitial fluids that bathe the cells of the body. The volume and the composition of the interstitial fluids must remain within certain limits and kept relatively free of wastes. Maintaining homeostasis of the interstitial fluids is the job of the excretory system, and it can be challenging. The nature of the challenge depends on the environment of the animal and its lifestyle. Some animals such as desert insects and small mammals may never experience free water in their environments. They must be able to live their entire lives without drinking. All animals derive water from the metabolism of food, but to make that amount of water do, desert animals must conserve it. Accordingly, they excrete wastes that are extremely concentrated. Insects excrete semisolid wastes and desert rodents excrete urine that is so concentrated it contains crystals of solute.

Animals that live in fresh water have the opposite problem; water is continuously entering their bodies by osmosis and with the food they eat, so they must constantly bail themselves out by producing copious amounts of dilute urine while they conserve the solutes their bodies need. We will see the adaptations such animals have to maintain salt and water balance, but to show how flexible physiological adaptations to the environment can

be, we will discuss an animal that experiences both extreme conditions, and within minutes of each other. We will consider the problems of vampires—not the horror film kind, but the bat kind.

Vampire bats are small tropical mammals that feed on the blood of other mammals, such as cattle. The bat lands on an unsuspecting (usually sleeping) victim, bites into a vein, and drinks blood—a high-protein, liquid food. The bat has only a short time to feed before the victim wakes. To maximize the volume of blood it can ingest, it eliminates water from its food as fast as it can by producing a lot of very dilute urine. The warm trickle down the neck of the victim is not blood!

Once feeding ends, this high rate of water loss must stop. Now the vampire bat is digesting protein and must excrete large amounts of nitrogenous breakdown products while conserving its body water. Within minutes, the excretory system of the vampire bat switches from producing abundant, very dilute urine to producing a tiny amount of highly concentrated urine. The vampire bat rapidly switches from an excretory physiology typical of a mammal living in an environment with abundant fresh water (copious amounts of dilute urine) to an excretory physiology typical of a mammal living in an arid desert (small amounts of concentrated urine).



AUDIO

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Answer the questions

- How can animals such as desert insects and small mammals be able to live their entire lives without drinking?
- Which animal can live without water during his lifetime? Why?