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LICKING THEIR FOREARMS KEEPS KANGAROOS COOL

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YOUNG REVIEWERS:

SIA
AGE: 11

VINCI
AGE: 11

WOO
AGE: 10

When it is hot, we sweat. By doing this, we create a little wet layer on our skin. When this wet layer evaporates, it absorbs our body heat and carries it away as it evaporates. By spreading saliva on their forearms, Australia's Red kangaroo creates a similar wet layer on their forearms. The skin on their forearms is very thin, which makes it easy for the body heat to dissipate into the environment. Moreover, right beneath their forearms lies a large venous network where blood circulation is high, which allows a large amount of heat to build up in this area and also be gotten rid off. Licking their forearms is an important adaptation of the Red kangaroo to the hot and arid environment they live in. Especially now that the Red kangaroo's habitat is heating up due to climate change, being adapted is important for these marsupials to survive.

THE KANGAROO: A HOPPING MARSUPIAL

MARSUPIALS

Mammals that have pouches in which their babies develop. Examples include kangaroos, koalas, and wallabies.

You might know them, the big hopping animals that live in Australia: kangaroos. Kangaroos are the largest living **marsupials** on our planet, which means their young—called joeys—grow in the mother's pouch. Young kangaroos are born only 33 days after mating, so they are still tiny and not fully developed. At birth, the 2.5 cm long joey attaches itself to the nipple inside its mother's pouch, where it will live and feed for the next 8 months, until it has grown enough to leave the pouch.

Kangaroos do not walk when they move from place to place—they hop. Their powerful hind legs help them move forward, while their big tail helps them to maintain balance.

ARID

Very dry, with very little to no rain.

The largest living kangaroo species is called the red kangaroo (Figure 1). Red kangaroos live in Australia's hot and **arid** desert zones, where rainfall is less than 250 mm a year. This is almost half the amount of rain that falls on Australia as a whole each year (~510 mm). Not only is the habitat of red kangaroos extremely dry, it is also very hot, with temperatures reaching up to 40°C.

Figure 1

A red kangaroo (Illustration 293704107 | Kangaroo © Bualong Sadsana | Dreamstime.com). From https://www.dreamstime.com/red-kangaroo-australia-made-generative-ai-illustration-generated-wildlife-concept-image293704107.

To survive the hot, arid conditions of Australia's desert zones, animals have developed multiple adaptations to beat the heat. Koalas, for example, have a very interesting way of keeping cool [1]. During hot periods, koalas hug tree trunks. The temperature of tree trunks is lower than the air temperature, so trunks provide the perfect environment for koalas to cool down. Apart from tree-hugging koalas, many other

Australian animals have interesting ways of keeping cool, including the red kangaroo. When it is hot, these kangaroos lick their forearms! But why exactly do they do this?

SWEAT: A WET LAYER THAT COOLS THE BODY DOWN

If you are outdoors on a hot summer day, your body temperature might start to rise in response to the heat. Keeping the body from getting too hot is important because, above a certain temperature, bodily functions do not happen the way they should. To get rid of excess heat, blood is carried to the body's surface, so heat can **dissipate** through the skin and into the environment. People also start sweating when they are hot. Sweat glands can detect a rise in body temperature and start producing sweat. Sweat released onto the skin creates a thin wet layer. When this wet layer evaporates, it carries away body heat in the process. This is called **evaporative heat loss** (Figure 2).

DISSIPATE

To gradually disappear or fade away.

EVAPORATIVE HEAT LOSS

A way of getting rid of heat by the evaporation of water. To evaporate, water absorbs heat from the body and carries it away as it turns to a vapor, resulting in cooling.

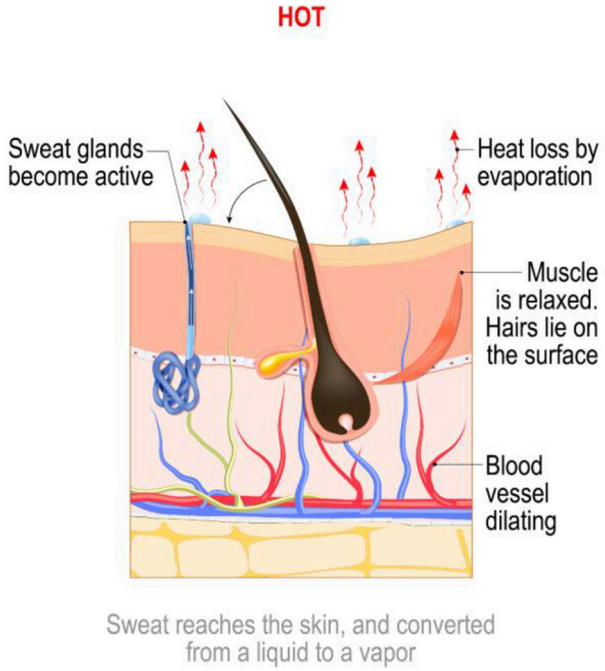

Figure 2

Thermoregulation (Illustration 169786434 © Designua | Dreamstime.com). From https://www.dreamstime.com/skin-thermoregulation-body-temperature-regulation-skin-thermoregulation-body-temperature-regulation-if-body-too-hot-image169786434.

Not all animals have sweat glands, which means that not all animals can produce sweat. To avoid becoming overheated, animals that cannot sweat have developed other strategies to cool down through evaporative heat loss. For example, elephants spray water on their ears with their trunks and then flap their ears up and down. The water on their ears acts like sweat does—it evaporates and helps the elephants to cool down. Pigs, hippos, and buffalo take mud baths to beat the heat. Just like sweat or water, mud helps these animals to lower their body temperature through evaporative cooling [2]. You might wonder

why these animals prefer to bathe in dirty mud instead of clean water. Mud actually evaporates slower than water, helping pigs, hippos, and buffalo feel cool for longer! Maybe the next time it is hot, you should consider swapping your swimming pool for a nice little mud bath.

Kangaroos do have sweat glands and thus can produce sweat when they are hot. However, these glands are only activated during exercise. If kangaroos are not exercising, their sweat glands become inactive to prevent excessive water loss in their dry habitat. To keep cool even when not exercising, kangaroos have developed another method of evaporative cooling—they lick their forearms when they are hot. By spreading saliva on their forearms, they create a wet layer that works the same way sweat does, helping them to lower their body temperature (Figure 3) [3].

Figure 3

A kangaroo licking its forearm in the Australia Zoo (picture taken in Australia Zoo on March 20th, 2023).

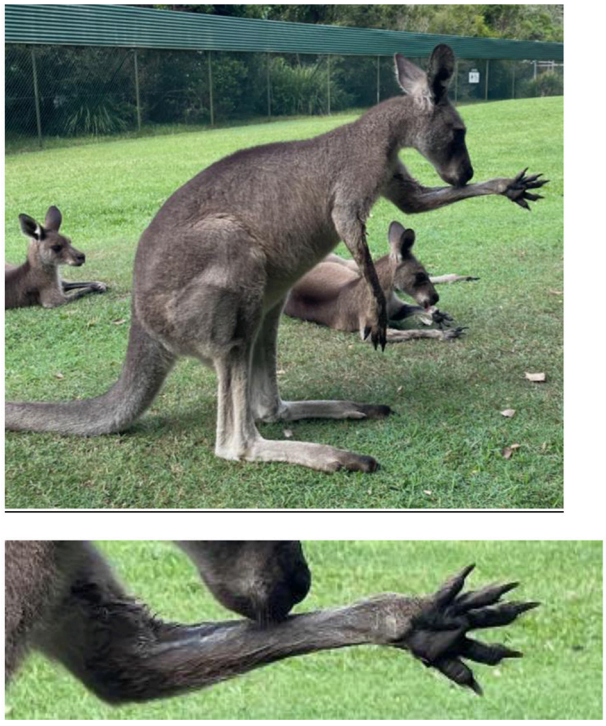

Figure 3

Joeys learn this forearm-licking behavior by watching and imitating their mothers. So, it is not a behavior that kangaroos are born knowing. Just like we have to learn basic life skills as babies, like holding a spoon, joeys have to learn to lick their forearms [4].

WHY THE FOREARMS?

Kangaroos have a large network of veins right beneath the skin of their forearms [3]. When kangaroos are hot, blood circulation is high in this area, which can help get rid of a lot of heat. In addition, the skin on

kangaroos' forearms is very thin. This makes it easier for the heat from the veins to dissipate to the surface.

HOW IS CLIMATE CHANGE AFFECTING KANGAROOS?

Earth's temperatures are rising due to climate change, causing problems like heat waves, droughts, and melting ice caps. Between 1910 and 2011, the average global temperature increased by 0.7°C. Within this same time period, Australia's average temperatures increased even 0.2°C more than the global average [5]. This rise in temperature could threaten Australia's wildlife [6]. Most Australian animals, like the red kangaroo, have natural ways to survive Australia's heat. However, as climate change continues, these adaptations might not be enough to help those animals to survive.

As Australia gets warmer, kangaroos might have to cool down their bodies even more, by licking their forearms more often. If kangaroos lick their forearms too much in an effort to cool down, they could become dehydrated from losing too much water as saliva. Arm-licking behavior has been observed in other kangaroo species too, such as eastern gray kangaroos and western gray kangaroos, indicating that these species could also be in danger of dehydrating if temperatures get too high [7].

Animals all over the world—not just in Australia—are threatened by climate change. Luckily, there are many ways we can fight back. Even as an individual, you are able to reduce your impact on climate change. Find out more about how you can help in this Frontier for Young Minds article.

WRAPPING UP WHAT YOU HAVE LEARNED

As you have learned, sweating is an important adaptation that allows the body to cool down so that it keeps functioning properly even when it is hot outside. Red kangaroos, marsupials living in the Australian desert, have a remarkable adaptation to cope with the heat: licking their forearms. By doing this, they spread saliva on their skin, which evaporates and helps their bodies cool down.

However, this behavior also has a downside, because spreading saliva results in water loss. With Australia's rising temperatures and decreasing availability of water due to climate change, red kangaroos risk becoming dehydrated, which can be fatal. Now more than ever, we need to protect animals all over the world by doing our best to tackle climate change [8]. It is important to protect fascinating species like the red kangaroo, because they, and other animals, might have even more interesting life hacks to teach us!

REFERENCES

1. Briscoe, N. J., Handasyde, K. A., Griffiths, S. R., Porter, W. P., Krockenberger, A., and Kearney, M. R. 2014. Tree-hugging koalas demonstrate a novel thermoregulatory mechanism for arboreal mammals. *Biol. Lett.* 10:20140235. doi: 10.1098/rsbl.2014.0235
2. Geiling, N. 2014. From panting to pooping, 8 Weird ways animals keep cool. *Smithsonian Magazine*. Availalbe online at: https://www.smithsonianmag.com/science-nature/panting-pooping-8-weird-ways-animals-keep-cool-180952226/ (accessed June 5, 2024).
3. Needham, A. D., Dawson, T. J., and Hales, J. R. S. 1974. Forelimb blood flow and saliva spreading in the thermoregulation of the red kangaroo, Megaleia rufa. *Comp. Biochem. Physiol. Part A Physiol.* 49:555–65. doi: 10.1016/0300-9629(74)90568-4
4. Behaviours for Survival. z.d.. Molly's Biome Investigation. Available at: https://sclerophyllforest.weebly.com/behaviours-for-survival.html (Retrieved December 13, 2024).
5. Head, L., Adams, M., McGregor, H. V., and Toole, S. 2014. Climate change and Australia. *WIREs Clim. Change* 5:175–97. doi: 10.1002/wcc.255
6. Narayan, E., and Williams, M. 2016. Understanding the dynamics of physiological impacts of environmental stressors on Australian marsupials, focus on the koala (*Phascolarctos cinereus*). *BMC Zool.* 1:2. doi: 10.1186/s40850-016-0004-8
7. Dawson, T. J. 2012. *Kangaroos*. Clayton South, VIC: CSIRO Publishing.
8. Joseph, J., Charalambous, R., Pahuja, H., Fox, D., Jeon, J., Ko, N. Y., et al. 2023. *Impacts of climate change on animal welfare*. Wallingford; Oxfordshire: CABI Reviews.

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

SIA, AGE: 11

Sia is a witty girl who enjoys watching short videos and has amassed a lot of information due to this. She is a student of class seven and takes pleasure in science and social studies. She loves to swim. She has a very creative hand in sketching and is still exploring what she will be when she grows up.

VINCI, AGE: 11

I am a Portuguese 11-year-old boy, same school and I really like evolution, natural history and history.

WOO, AGE: 10

I am a 10-year-old Korean boy, that boards in a school in Cambridge, I love sciences specially chemistry and physics.

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My name is Sabine and I just finished my bachelor of biology at Utrecht University in the Netherlands, where I focused on wildlife conservation, animal welfare, and behavior. During my bachelor's, I went on an exchange to Australia to study wildlife conservation and animal welfare. At the moment, I am taking a gap year before starting my master's in forest and nature conservation at Wageningen University in the Netherlands. Currently, I am conducting research on animal welfare and behavior at Gaia ZOO in Kerkrade (The Netherlands). *sabine191020@gmail.com

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