

# Taking the temperature of the painted turtle

## SCIENTIFIC NAME

*Chrysemys picta*

## TAXONOMY

PHYLUM: Chordata

CLASS: Mammalia

ORDER: Reptilia

FAMILY: Emydidae

## Physical description

The painted turtle is the most abundant turtle in North America. Four regional subspecies exist; although their ranges overlap and border populations interbreed, the subspecies differ in appearance, habitat and diet. The western painted turtle (*C. picta bellii*) is the most common and has the most colorful shell, featuring a red pattern on the plastron. The carapace in all subspecies is dark and smooth, measuring 10–25 cm in the adult female; the male is smaller at 7–15 cm and only 300 g compared with the average adult female weight of 500 g. Like the carapace, the turtle's skin is olive to black in color with red, orange or yellow stripes on the neck, limbs and tail. A large yellow streak extends behind each eye, and two wide yellow stripes along the chin meet at the tip of the jaw. The painted turtle's feet are webbed and clawed. Turtles reach sexual maturity at 2–9 years for males and 6–16 years for females and can live for 40 years or more in the wild.



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nesting sites several times. Females may alter nesting time in response to ambient temperatures, digging nests when their body temperatures are an optimal 29–30 °C (ref. 2). The female digs using her hindlimbs, deposits her eggs (usually 4–12), covers them with layers of soil and leaves them to develop for 72–80 days until they hatch in late summer. The sex of the hatchlings is determined by the temperature of the nest during the middle third of the incubation period: temperatures of 22–26 °C produce male hatchlings, whereas those >28 °C produce females<sup>3</sup>.

Not all hatchlings leave the nest immediately; some remain throughout the winter and emerge the next spring<sup>4</sup>. To withstand exposure to subfreezing winter temperatures, the turtles enter a 'supercooled' state made possible by adaptations to their blood and skin<sup>4</sup>.

## Research résumé

Because of its unique sensitivities and adaptations to temperature, the painted turtle has been studied to decipher the evolutionary underpinnings of adaptation to extreme environments and the ecological implications of climate change<sup>5</sup>. Sequence analysis of the painted turtle genome identified various genes involved in the turtle's unique physiology, some of which have analogs implicated in human diseases; further analysis of these pathways may lead to better management of these disorders<sup>6</sup>. But the turtle's ability

to reproduce is threatened by global climate change: increasing temperatures may cause all hatchlings to be female<sup>7</sup>.

## Ecology

Painted turtles inhabit slow-moving fresh waters with logs or rocks at the surface, where they bask for warmth, and soft muddy bottoms rich in vegetation, where they hide, hunt and hibernate during winter. Hibernating painted turtles do not breathe; adaptations to their blood, brain, heart and shell allow them to survive the long period of oxygen deprivation<sup>1</sup>. They emerge from hibernation relatively early in spring, when water temperatures reach 15–18 °C. When he can bask to an internal temperature of 17 °C, the male painted turtle starts producing sperm. He performs a courtship ritual in which he faces a female, waves his long front claws and then strokes her face and neck with them. A receptive female may reciprocate the gesture by stroking the male's forelimbs.

After mating, in late spring to mid-summer, the female leaves the water to find a nesting site. Females may return to the same

1. Jackson, D.C. Hibernating without oxygen: physiological adaptations of the painted turtle. *J. Physiol.* **543**, 731–737 (2002).
2. Ernst, C.H. & Lovich, J.E. *Turtles of the United States and Canada* 2nd edn. 185–259 (The Johns Hopkins University Press, Baltimore, MD, 2009).
3. Schwarzkopf, L. & Brooks, R.J. Sex determination in northern painted turtles: effect of incubation at constant and fluctuating temperatures. *Can. J. Zool.* **63**, 2543–2547 (1985).
4. Packard, G.C., Packard, M.J., Morjan, C.L. & Janzen, F.J. Cold-tolerance of hatchling painted turtles (*Chrysemys picta bellii*) from the southern limit of distribution. *J. Herpetol.* **36**, 300–304 (2002).
5. Valenzuela, N. The painted turtle, *Chrysemys picta*: A model system for vertebrate evolution, ecology, and human health. in *Emerging Model Organisms: A Laboratory Manual Vol. 2* (Cold Spring Harbor Laboratory Press, Woodbury, NY, 2009).
6. Shaffer, H.B. *et al.* The western painted turtle genome, a model for the evolution of extreme physiological adaptations in a slowly evolving lineage. *Genome Biol.* **14**, R28 (2013).
7. Telemeco, R.S., Abbott, K.C. & Janzen, F.J. Modeling the effects of climate change-induced shifts in reproductive phenology on temperature-dependent traits. *Am. Nat.* **181**, 637–648 (2013).