生物策略格式

KJC, 2019/10/21

類別	生物策略 (Strategy)
生物策略 STRATEGY	血流可以調節熱交換 (Blood flow regulates heat exchange)
生物系統 LIVING SYSTEM	美洲短吻鱷 *Alligator mississippiensis* (American alligator)
功能類別 FUNCTIONS	#保護免受溫度危害 #Protect from temperature
作用機制標題	短吻鱷的皮膚藉由增加血流來調節熱交換 (Skin of alligators regulates heat exchange by increasing blood flow)
生物系統/作用機制示意圖	 

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

文獻引用 (REFERENCES)

「短吻鱷擁有幾個調節體溫的能力讓設計師很感興趣。第一，當短吻鱷無法得到足夠氧氣時有下降體溫的能力。這似乎抵銷了會發生在換氣、耗氧、酸鹼平衡和乳酸水平的改變。第二，短吻鱷升高體溫的速度比降溫的速度還要快。加熱與降溫速率的比值決定於身體的重量，通常為 2-3。在短吻鱷 5 公斤時，這個比例會達到最大值，顯示控制熱交換有一個最佳的身體大小。短吻鱷能快速升高體溫的原因，在於皮膚裡的血流增加了。在降溫時，血流並沒有改變。事實上，根據一個研究的結果顯示，血流跟降溫完全沒關係。當進入四肢的血流被封阻時，升溫的速率會大幅下降，而降溫速率並未改變。對調控熱交換來說，也許有個最合適的身體大小。短吻鱷 5 公斤時，加熱速率與散熱速率的比值會達到最大值。短吻鱷升高體溫會比降低體溫還快兩倍。在升溫時，皮膚裡的血流量會比降溫時的來得多。」（由仿生協會提供）

“Alligators possess several thermoregulatory abilities that may be of interest to architects. First, alligators have the ability to drop their body temperature when they are not receiving enough oxygen. This seems to offset changes that would otherwise occur in ventilation, oxygen consumption, acid-base balance, and lactate levels. Second, alligators warm their bodies much more quickly than they cool off. The ratio of rate of heating to rate of cooling is dependent on

body mass, but is generally 2-3. The ratio is maximal when the alligator is 5 kg, indicating that there is an optimal size for control of heat exchange. The speedy rate of warming in alligators can be attributed to increased blood flow in the skin. During cooling, blood flow does not change. In fact, the results of one study suggest that blood flow is not at all involved in cooling. When blood flow to the appendages was occluded, the rate of warming dropped significantly, while the rate of cooling did not change. There may be an optimum body size for the control of heat exchange. The ratio of rate of heating to rate of cooling is maximum when the alligator is 5 kg. Alligators warm their bodies up to twice as fast as they cool down. There is greater blood flow in the skin during warming than during cooling." (Courtesy of the Biomimicry Guild)

參考文獻清單與連結 (REFERENCE LIST)

G.C. Branco and G.C. Branco. (1977). Weinberg-Salam model with two Higgs doublets and the rule. *Physics Letters B* 68: 330-334. (https://doi.org/10.1016/0370-2693(77)90487-7)

Turner, J.S. and C. R. Tracy. (1985). Body size and the control of heat exchange in alligators. *Journal of Thermal Biology* 10: 9-11. (https://www.sciencedirect.com/science/article/pii/030645658590004X?via%3Dihub)

Turner, J.S. and C. R. Tracy. (1983). Blood flow to appendages and the control of heat exchange in American alligators. *Physiological Zoology* 56: 195-200. (https://doi.org/10.1086/physzool.56.2.30156051)

Branco, L. G. S., H. O. Poertner, and S. C. Wood. (1993). Interaction between temperature and hypoxia in the alligator. *Am. J. Physiol.* 265: 1339-1343. (https://doi.org/10.1152/ajpregu.1993.265.6.r1339)

延伸閱讀:

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://en.wikipedia.org/wiki/alligator_mississippiensis

文章貢獻/編修者與日期:

傅國翔翻譯 (2019/04/22)；朱天愛編修 (2019/12/19)；吳晧編修 (2020/01/04)；譚國鎏編修 (2020/05/26)；紀凱容編修 (2020/11/26)；施習德編修 (2020/12/15)

AskNature 原文連結

https://asknature.org/strategy/blood-flow-regulates-heat-exchange/