

# Living on the Edge: A Day in the Life of a Hummingbird

by

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## Part I – Wake-up Call

It is early morning in May in southern California. As I look out the window I can see an Anna's hummingbird hovering over flowers in my neighbor's yard. This brings back fond memories of my time in South Africa when I used to see sunbirds (closely related to hummingbirds) throughout the summer months.

The hummingbird quickly flies over the fence and seems interested in my flowering trumpet vine growing alongside the house. The speed at which it moves before coming to a dead stop amazes me. Its movement is not fluid and gentle but rather abrupt and hasty. The little bird seems intent on probing its long bill into as many flowers on my vine as it can. As it makes its way methodically from one flower to another with pinpoint precision, I can hear the gentle low pitch buzzing of its tiny wings.

As I see and hear all this, I wonder to myself. "Why is this little hummingbird so hungry at this time of the day? It has all day to feed. Why gulp down as much as possible first thing in the morning?"

### Questions

1. Do floral nectar concentrations vary throughout the day? Why do nectar concentrations affect the timing of feeding during the day?
2. What are some of the daily osmotic challenges faced by hummingbirds? How do they cope physiologically with low and high concentrations of nectar?

## Part II – The Day’s Routine

As I concentrate on this tiny bird out of the corner of my eye, my gaze spots another one coming closer. The first bird seems irritated by the presence of the second. I guess I would be irritated if I were feeding on these nice flowers minding my own business and another bird came up to me expecting me to share what little food was available. Both birds swoop around one another with the military precision that would marvel an air force pilot. Each one seems intent on displacing the other for the limited number of flowers left on which to feed.

Suddenly and without seemingly a flinch, the second bird disappears from sight. The original visitor continues unabated feeding furiously on whatever flowers have not yet been probed. I continue with my daily chores until noon, but I cannot seem to get my mind off what I had seen earlier today. By now I am hungry, as I have not eaten any breakfast, unlike my little feathered friend who gorged himself on my flowers earlier this morning. I sit down to have lunch, then take a midday nap. When I awake I peer out of the window where earlier this morning I had witnessed the hummingbird feed. There is no sign of him now.

### Question

3. Why don't you see hummingbirds feed during the hottest part of the day?

Curious about how a tiny bird could survive on only a liquid diet I decide to do some internet research on hummingbirds. I find and read articles about their kidneys and lower intestine and how both operate. Interestingly it is not quite the same as the functioning in mammals.

### Questions

4. From the material presented in the introductory lecture, explain how the mammal nephron produces a concentrated urine. In your answer explain how the countercurrent multiplier mechanism operates, the importance of the design of the thin descending and thick ascending limb of Henle, and the length of the loop of Henle.
5. The article by Casotti et al. (1998) discusses three renal adaptations that enable Anna's hummingbird to survive on a high water flux, low ion diet. What are they and how do they operate?



Figure 1. A male Anna's Hummingbird, *Calypte anna*. Credit: Brocken Inaglory, CC BY-SA 3.0, <[https://commons.wikimedia.org/wiki/File:Male\\_Calypte\\_anna\\_in\\_ggp\\_2.jpg](https://commons.wikimedia.org/wiki/File:Male_Calypte_anna_in_ggp_2.jpg)>.

## Part III – Time to Sleep

It is close to dusk, around 8 pm but still warm outside, as I sit beside the window reading a book from one of my favorite authors. He is probing that same trumpet vine, making that same rapid motion from flower to flower trying to extract every last drop of that precious fluid before nightfall.

This time he only hovers for a few minutes then leaves. Silence at last. After about an hour a cool wind begins blowing and the temperature drops until it gets quite chilly. I close the window, then go off to bed.

I don't see my feathered friend again until early again the next morning.

Hummingbirds cannot feed in the dark; he probably came to the flower because there was light from the nearby window. Since they have a high rate of metabolism and a high body temperature they must undergo torpor overnight.

### Questions

6. What is torpor and why is it an important physiological adaptation for survival?
7. How much of a decrease is there in  $O_2$  consumption between normothermy and torpor? How long does torpor typically last?



Figure 2. Anna's Hummingbird, *Calypte anna*. Credit: Brocken Inaglory, CC BY-SA 3.0, <[https://commons.wikimedia.org/wiki/File:Hummingbird\\_in\\_ggp\\_21.JPG](https://commons.wikimedia.org/wiki/File:Hummingbird_in_ggp_21.JPG)>.

