HUMAN BODY

Bicycling and Calories

Take-Home Experiment Write Up

The first run of this experiment occurred on an afternoon of a hot August day with a temperature of 30^{o}C. Four bikers weighed themselves just prior to biking, and weighed their full water bottles as well. They then biked 12.8 km in 55 min, travelling at a rate of 14 km/h, being sure to drink water frequently so that they stayed hydrated. During the bike ride they recorded their time at landmarks so that they knew how fast they were travelling. After their bike ride, they weighed themselves and their now mostly empty water bottles, noting that the different in the weight was due to the sweat they produced while biking.

A few days later, the same bikers on the same bikes wearing the same clothing completed the bike ride again, except that this time they did it early in the morning while it was still only 16^{o}C. They made sure that they got to each land mark at approximately the same time as they had a few days earlier to that they were travelling at the same speed and weren't going faster because it was cooler out. Before and after their bike ride they weighed both themselves and their water bottles.

It was vital that participants were weighed without clothing so that the sweat in their clothes did not contribute to their weight. All four participants wore shorts and t-shirts, most of which were spandex biking shorts/jerseys. Also, participants refrained from spilling water or spitting it out so that all of the water that leaves their bottles goes into their bodies. Because the only substance going in/out of their bodies during the period between when they were weighed was water and sweat, all of the weight change is due to sweating.

Hot Day (30^{o} C)	Mass of Person Before(kg)	Mass of Water Before(kg)	Mass of Person After(kg)	Mass of Water After(kg)	Mass of Water Drunk(kg)	Total Mass Change(kg)
Biker 1	86.2	0.9	85.7	0.4	0.5	1
Biker 2	68.2	1.2	68.2	0.4	0.8	0.8
Biker 3	63.7	0.9	63.6	0.0	0.9	1
Biker 4	93.2	0.9	92.8	0.4	0.5	0.9

Table 1. Sweat produced on a hot day – the total change of weight when 4 bikers rode for 55 minutes on a day where the temperature was 30^{o}C.

COLD DAY (16 C)	Mass of Person Before(kg)	Mass of Water Before(kg)	Mass of Person After(kg)	Mass of Water After(kg)	Mass of Water Drunk(kg)	Total Mas Change(kg)
Biker 1	85.5	0.6	85.3	0.5	0.1	0.3
Biker 2	67.6	0.6	67.5	0.5	0.1	0.2
Biker 3	64.0	0.6	63.9	0.5	0.1	0.2
Biker 4	94.4	0.6	94.1	0.5	0.1	0.4

Table 1. Sweat produced on a cool day – the total change of weight when 4 bikers rode for 55 minutes on the same route on a day where the temperature was 16°C.

When comparing the weights of the bikers from the hot day and the cold day, it was found that on the hot day, bikers lost an average of 1 kg of sweat while on the cool day they only lost an average of 0.3 kg of sweat.

Let's look at the power produced and lost by a body on a cooler day and a hotter day.

For the cooler day (16°C):

Power Produced: Roughly 400 W

Lost:

Power is mainly lost due to sweat. The latent heat of vaporization of water at 16C is 2463 KJ/kg.

$$\begin{aligned} Q_{sweat} &= \frac{mL}{t} \\ &= \frac{(0.3\ \text{kg})(2{,}463{,}000\ \text{J/kg})}{55\ \text{min}\ (\frac{60\ \text{s}}{1\ \text{min}})} \\ &= 200\ \text{W} \end{aligned}$$

For the hotter day (30°C):

Produced from biking: 400 W

Power is mainly lost due to sweat. The latent heat on a 30°C day is 2463 KJ/kg.

$$\begin{aligned} Q_{sweat} &= \frac{mL}{t} \\ &= \frac{(1\ \text{kg})(2{,}429{,}000\ \text{J/kg})}{55\ \text{min}\ (\frac{60\ \text{s}}{1\ \text{min}})} \\ &= 700\ \text{W} \end{aligned}$$

Conclusion:

From the above calculation, we see that the bikers were sweating 500 W more on a sunny day than on a cool day. This extra heating comes from more solar power on the sunnier day and fewer losses to the environment.

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