

Physics of the Human Body, 1st Edition Additions and New Points
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Additions and new points for the First Edition (these and others have been added to the second addition)

1. Chapter 2, page 89: Problem 2.30: Woman have a curvature and reinforcement of the lumbar vertebrae to partially compensate for the load during pregnancy, as is addressed in K.K. Whitcome, L.Z. Shapiro, D.E. Lieberman: Fetal load and the evolution of lumbar lordosis in bipedal hominins. *Nature* 450, 1075-1078 (2007).
2. Chapter 3, page 138: The maximum height of a pole vault jump can actually be higher than that predicted in Eq. (3.62) because the vaulter can push up from the pole when it is vertical.
3. Chapter 3, page 151: For an interesting perspective on the physics of flipping during ski jumping, see H. Fountain: Up in the Air, and Down, With a Twist. *The New York Times*, Tuesday, February 2, 2010, page D1.
4. Chapter 3, page 172: For an analysis of basketball, see J.J. Fontanella: *The Physics of Basketball* (Johns Hopkins University Press, Baltimore, 2006).
5. Chapter 7, page 431: The energetics of treading water is addressed in D.C. Agrawal: Work and heat expenditure during swimming. *Phys. Educ.* 34, 220-226 (1999).
6. Chapter 9: Another perspective in the hydrodynamics of breathing is addressed in V.J. Menon, D.C. Agrawal: Physics of quiet and suffocative breathing. *Am. J. Phys.* 71, 474-478 (2003).
7. Chapter 13, page 769 (fits after last paragraph): Another example of positive feedback occurs during the final stages of death by chronic congestive heart failure [S. B. Nuland: *How We Die* (Vintage Books, New York, 1993) pages 27-30]. With this condition, the cardiac muscle is not able to contract enough to attain the needed stroke volume. Fluid backs up in the veins, causing increased pressure on the lungs and other organs and not enough blood is circulated to the organs. Instead of returning the system to a better set point, positive feedback worsens heart performance and, as damaging, causes the blood volume to steadily increase more and more beyond the optimal value. Poor heart performance leads to the thickening of the cardiac muscle, but the new muscle is of low quality and further decreases heart performance. The already limited blood flow to the cardiac muscle becomes increasingly insufficient to keep the increased amount of muscle healthy, which deteriorates performance even more. Concurrently, blood volume increases, increasing the load on the damaged heart, because of the response of the kidneys. The kidneys filter out some salt and water and normally remove them from circulation. For a healthy person this maintains the overall blood volume. For someone with congestive heart failure, such removal would decrease blood volume a bit and lessen the load on the heart, which would be good. However, the kidneys sense the lower blood flow and instead return to

circulation the salt and water it has filtered out in an effort to increase the low blood volume to normal levels. This undesirably increases the blood volume, which increases the load on the heart, which causes the heart to deteriorate further and pump less blood, which causes the kidney to increase total blood volume, and so on, accelerating the death process.