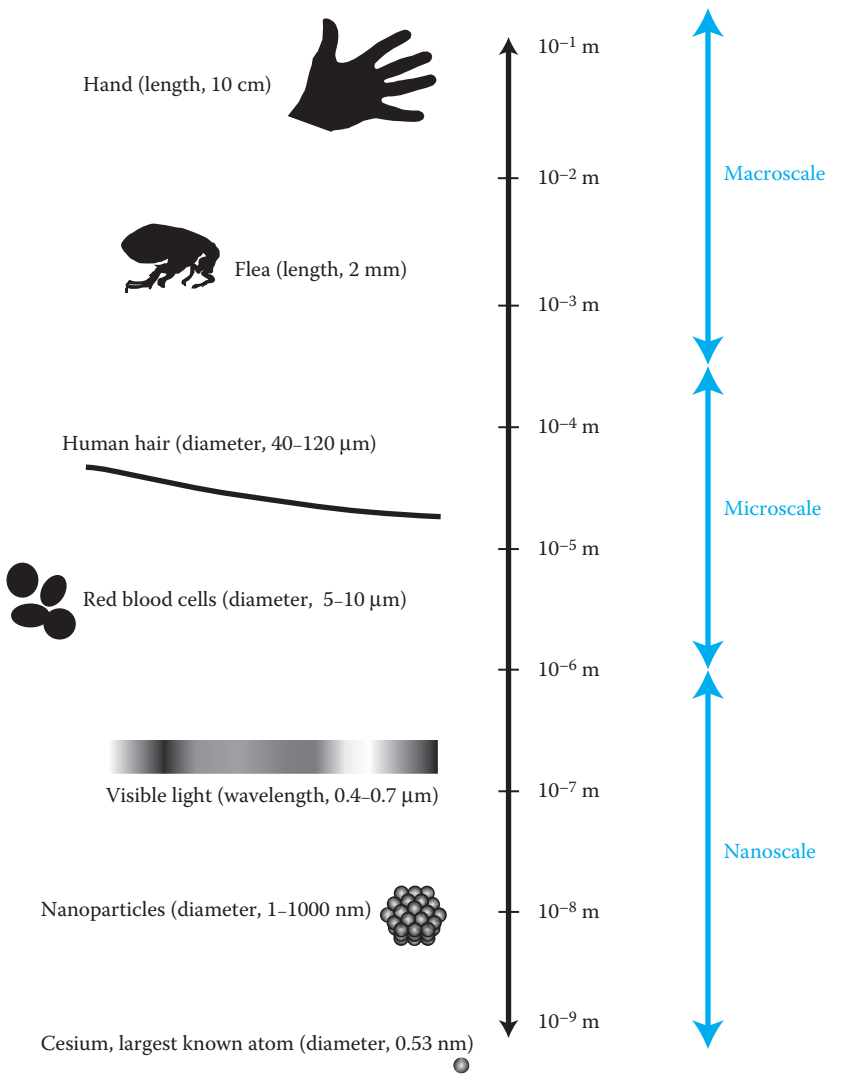

FIGURE 2.1 The macro-, micro-, and nanoscales. Keep in mind that the dimensional range of these scales varies, depending on whom you ask. Some say the nanoscale truly begins below 100 nm. The blue arrows therefore serve as general guides and should be thought to overlap.

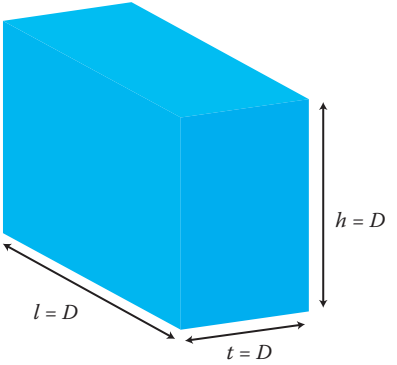

FIGURE 2.2 A rectangular solid with length l, height h, and thickness t. For order-of-magnitude scaling law calculations, we can express the size of this solid instead using a characteristic dimension D.

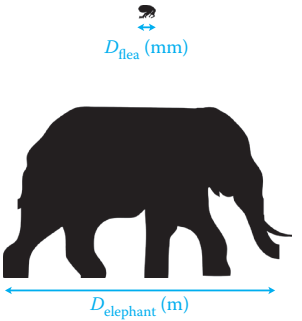

FIGURE 2.3 The flea and the elephant. The flea's characteristic dimension is best measured in millimeters, the elephant's in meters. This difference gives rise to very different strength-to-weight ratios for these very different creatures.

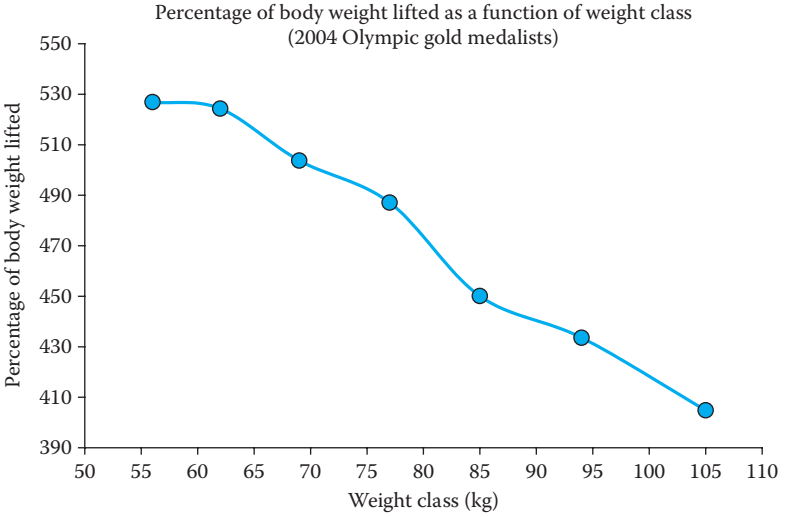

FIGURE 2.4 The advantage of scaling is evident in humans. Based on men's gold medal lifts from the 2004 Olympics in Athens, we see that the bigger athletes competing in the heavier weight classes cannot lift as great a percentage of their own body weight as the competitors in smaller weight classes. For example, the gold medalist in the 55-kg weight class lifted nearly 530% of his own body weight while the larger 105-kg medalist lifted 405% of his own body weight.

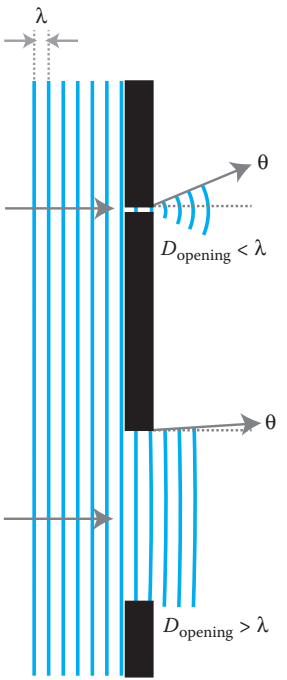

FIGURE 2.5 Waves of light with wavelength, λ, pass through a small and a large opening in a wall. The width of each opening is represented by the characteristic dimension $D_{opening}$. As the waves pass through the opening, they diverge at an angle, $\theta \approx \lambda/D$. If $D_{opening}$ is much larger than the wavelength, the waves hardly diverge at all.

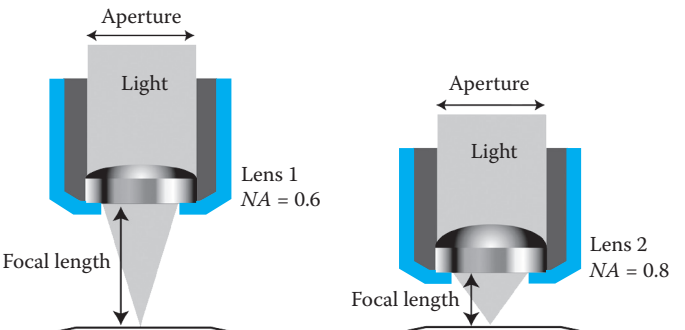

FIGURE 2.6 Numerical apertures of two lenses. The cone of light captured by lens 1 is not as wide as lens 2. In the case of a microscope, this means that lens 2 will gather more light diffracting off the sample for a brighter, higher resolution image. In the case of photolithography, the smallest spot we can illuminate with a given lens depends on the wavelength of light used.

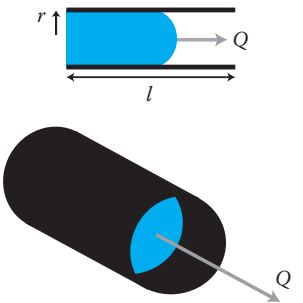

FIGURE 2.7 Fluid flowing through a small circular pipe. Changes in pipe radius affect the volumetric flow significantly more than changes in any of the other variables.

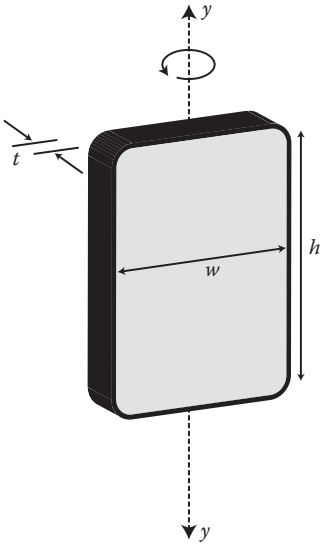

FIGURE 2.8 A micromirror. (For Homework Exercise 2.10.)