

Table S5. Pigment-content calculations.

Rod outer segment dimensions are given as diameter \times length. In all calculations below, the pigment concentration in the outer segment is assumed to be 3.5 mM (19). The cell dimensions are not exact. In particular, the mouse rod outer segment is too tiny for precise determination of its diameter and the length of the outer segment under recording by the pipette.

Note: With *Bufo* red rods, Baylor *et al.* (45) previously estimated the thermal-activity rate constant for A₁ rhodopsin to be $\sim 10^{-11} \text{ s}^{-1}$ at 20°C, based on the number of pigment molecules in the portion of the outer segment under recording being 2.0×10^9 . If the calculations were made by using a 3.5 mM pigment concentration, their rate constant would be $7.6 \times 10^{-12} \text{ s}^{-1}$, which is closer to our present value of $4.18 \times 10^{-12} \text{ s}^{-1}$ (Text Table 1).

Cell/Pigment	Source	Recorded part of outer segment
<i>Bufo</i> red rod/ A ₁ <i>Bufo</i> rhodopsin	This work	Dimensions: 7.5 \times 65.0 μm Volume = 2870 μm^3 Pigment molecules = 6.0×10^9
<i>Xenopus</i> rod/ A ₂ <i>Xenopus</i> rhodopsin	(59)	Dimensions: 6.4 \times 40 μm Volume = 1286 μm^3 , Pigment molecules = 2.7×10^9
Transgenic mouse rod/ A ₁ human red cone pigment	(46) and this work	1% (based on spectral shift) of total pigment content (see below) Pigment molecules = 6.5×10^5
Transgenic <i>Xenopus</i> rod/ A ₂ human red cone pigment	(59)	0.03% (based on spectral shift) of total pigment content (see above) Pigment molecules = 8.1×10^5
Mouse rod/ A ₁ mouse rhodopsin	(46) and this work	Dimensions: 1.4 \times 20 μm Volume = 31 μm^3 Pigment molecules = 6.5×10^7
<i>Bufo</i> green rod/ A ₁ <i>Bufo</i> blue cone pigment	This work	Dimensions: 7.3 \times 37 μm , Volume = 1548 μm^3 Pigment molecules = 3.3×10^9

19. F. I. Harosi, *J. Gen. Physiol.* **66**, 357 (1975).

45. D. A. Baylor, G. Matthews, K. W. Yau, *J. Physiol.* **309**, 591 (1980).

46. Y. Fu, V. Kefalov, D. G. Luo, T. Xue, K. W. Yau, *Nat. Neurosci.* **11**, 565 (2008).

59. V. Kefalov, Y. Fu, N. Marsh-Armstrong, K. W. Yau, *Nature* **425**, 526 (2003).