Supplementary Materials

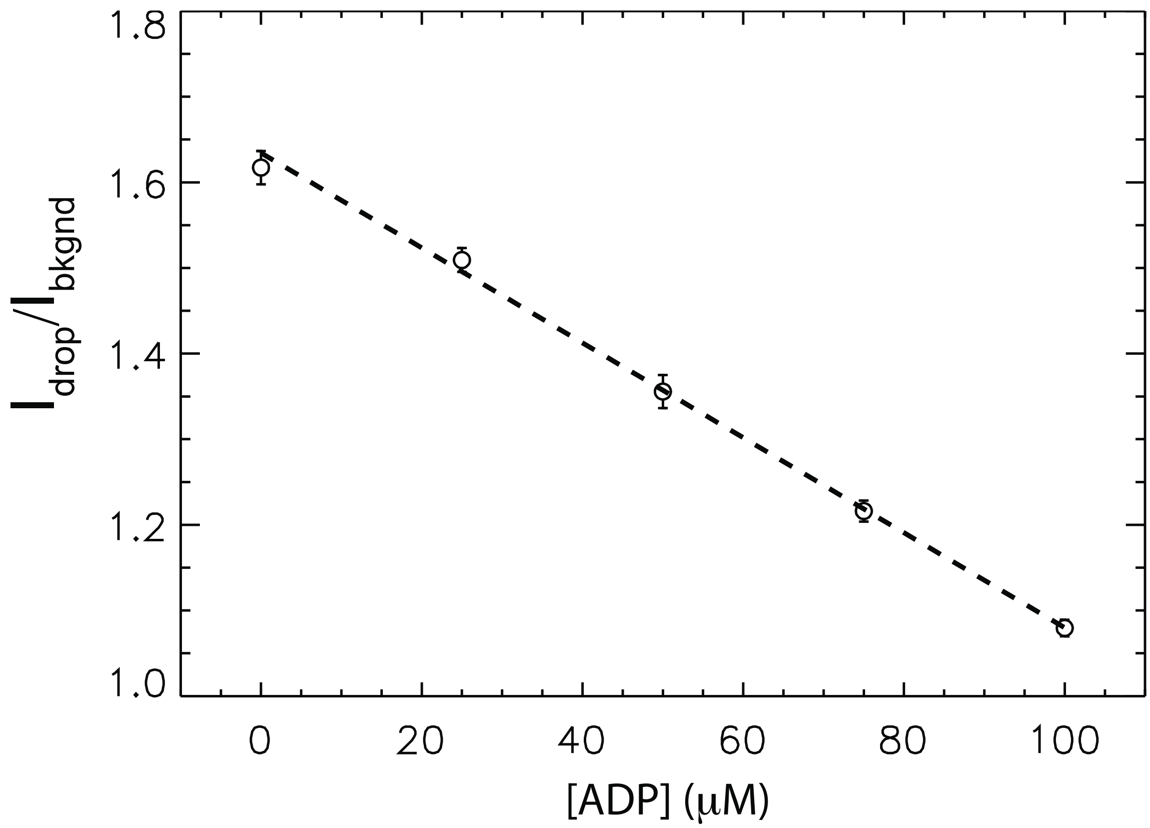

Figure S1: Calibration Curve of NADH fluorescence in droplet without sperm cell. Plot of mean intensity ratio of drop to background vs. [ADP]. Error bars are ± SEM (n=4). The dashed line is a least squares fit to the data.

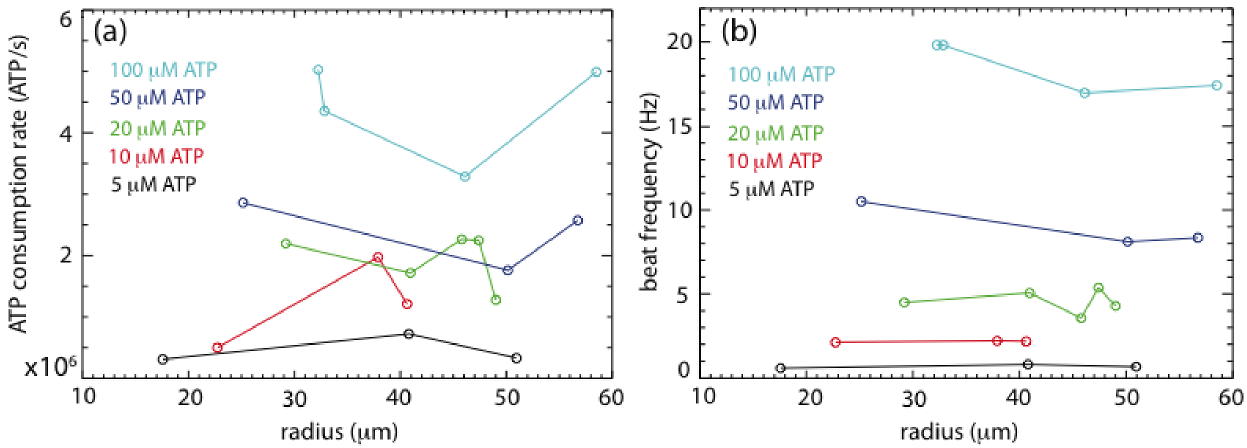

Figure S2: The analyses of droplet radius dependence in relation to ATP consumption rate (a) and beating frequency (b) for various [ATP] show absence of systematic trends with droplet size. Lines are eye-guides.

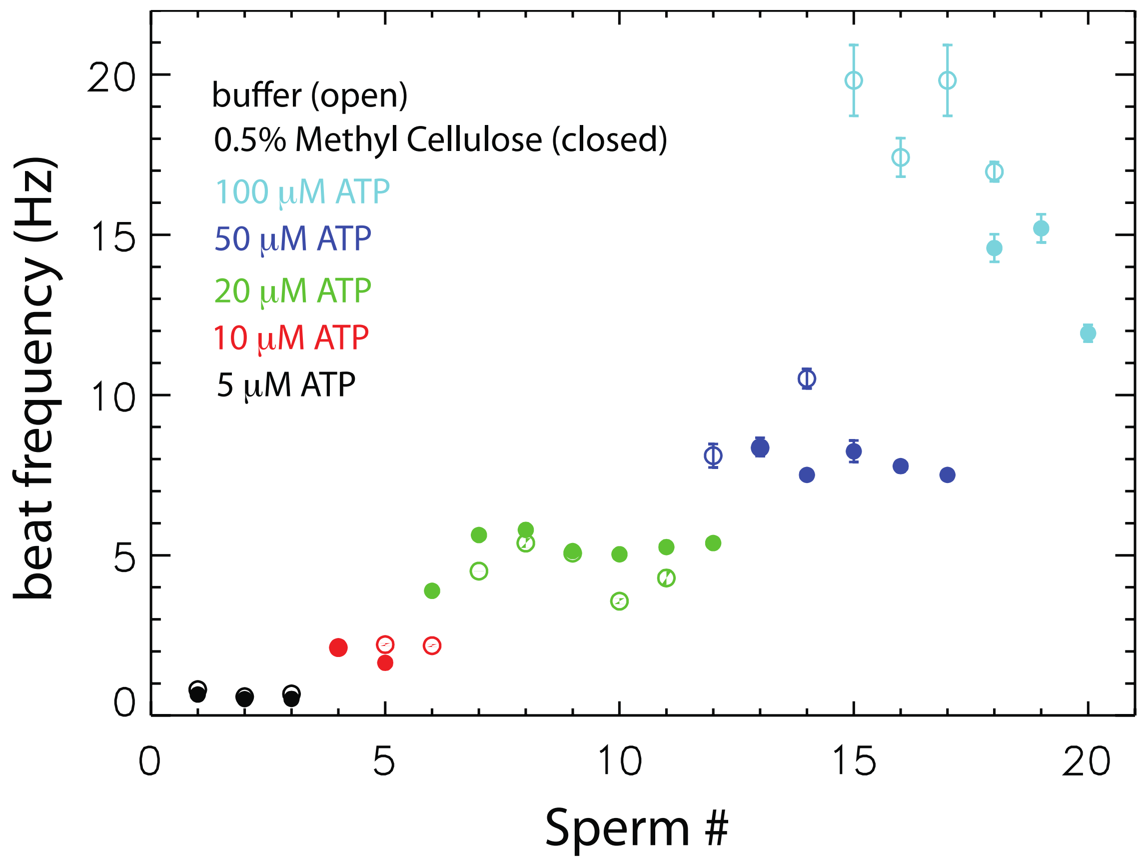

Figure S3: Measured beat frequency for each sperm in the dataset. Each point is the mean beat frequency ± SEM for n=5 independent measurements of the beating frequency at different times. Open circles are for sperm in standard buffer; filled circles are sperm in 0.5% w/v methyl cellulose (high viscosity). Error bars are smaller than the scatter between individual sperm at each concentration showing that inter-sperm variation is large relative to experimental resolution of the beating frequency.

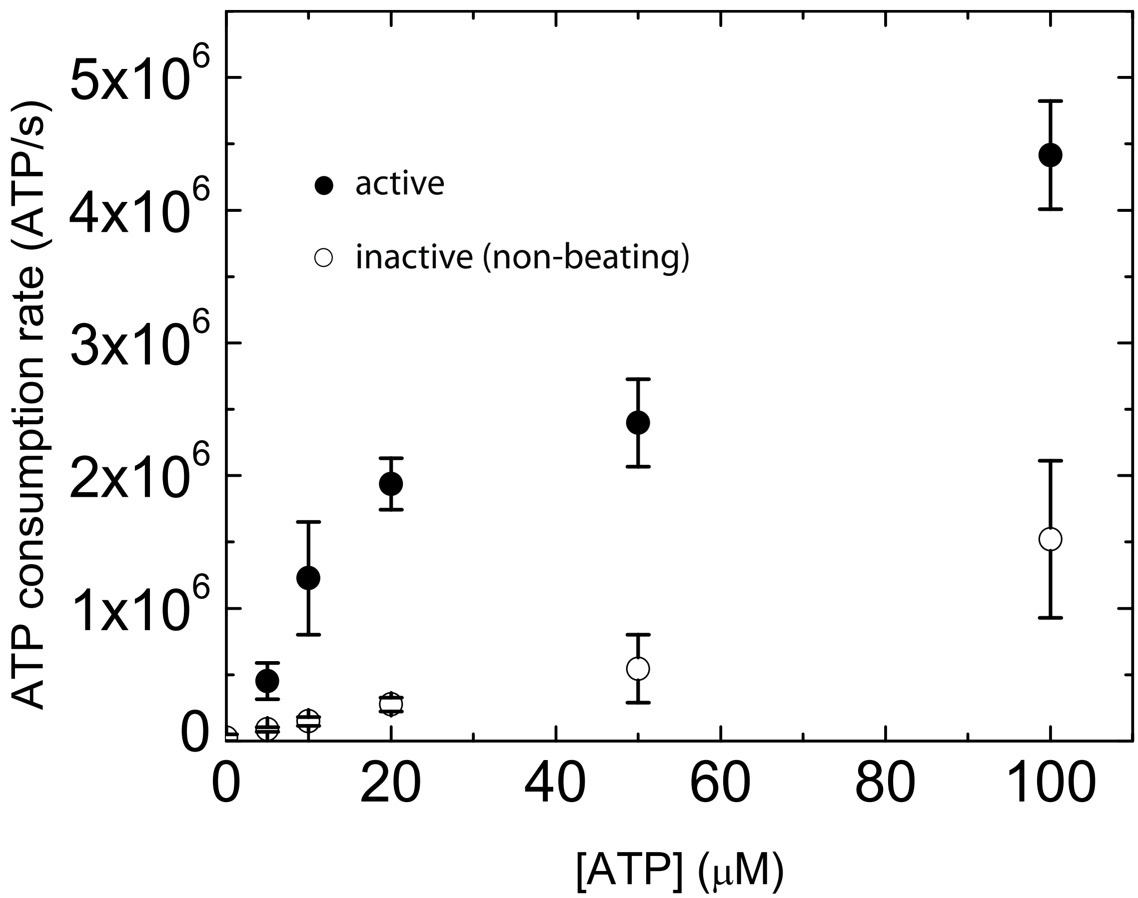

Figure S4: Mean ATP consumption rate vs. [ATP] for active and inactive (non-beating) sperm. Error bars are ± SEM (n=4).

	b (μm)	L (μm)	β (mPa s)	α (N m^2)	λ (μm)	f (Hz)	U (μm s^{-1})	P_{mech} (J s^{-1})	P_{drag} (J s^{-1})	P_{ATP} (J s^{-1})	ε_{chemo}	ε_{hydro}	ε_{swim}
Low Viscosity	5	45	4	4.5×10^{-21}	30	5	46.4	5.25×10^{-14}	1.94×10^{-16}	1.52×10^{-13}	0.34	.004	.001
High Viscosity	3.5	45	35	4.5×10^{-21}	21	4	38.7	9.15×10^{-14}	1.18×10^{-15}	1.52×10^{-13}	0.6	.013	.008

Table S1: Values of beating waveform parameters in Eq. (1) used to calculate various measures of efficiency for low and high viscosity beating waveforms for [ATP] = 20 μM sperm in buffer (low-viscosity) and 0.5% Methyl Cellulose (high-viscosity).

Movie S1: Movie of sperm swimming in droplet, [ATP] = 5 μM. Scale bar is 20 μm.

Movie S2: Movie of NADH fluorescence in two neighboring droplets. The left droplet does not contain a sperm cell, whereas the right droplet contains one actively swimming sperm. [ATP] = 50 μM. Scale bar is 20 μm.