

1.8 Respiration

Table 1.8.0: Numbers that Amaze

This table brings together some interesting numbers on respiration in animals, which are cited again in the individual tables below.

Interior lung surface	in humans	90 m ²
	in horses	500 m ²
Breaths per minute	in hummingbirds	250
	in mice	163
	in Eurasian siskins	114
Air volume inhaled and exhaled in one breath		
	in orcas	46,200 cm ³
	in horses	7,500 cm ³
	by comparison: in humans	500 cm ³
Maximum diving time	in beaked whales	120 min
	in leatherback turtles	120 min
	in bowhead whales	80 min
Maximum diving depth	in sperm whales	1,143 m
	in leatherback turtles	1,200 m
Oxygen consumption during exertion per kilogram body weight		
	in mice	28 g
	in humans	5.6 g

Table 1.8.1: Relative Lung Weight in Selected Vertebrates

Values vary greatly. For this reason, a range is given for humans. The figures given for animals are mean values. Figures represent percentage of body weight.

Data after CSICSÁKY 1984, HALTENORTH 1977

Species	%
Mammals	
African elephant	2.08
Beluga whale	2.70
Cat	1.04
Cattle	0.72
Chimpanzee	1.36
Common vole	1.70
Dog	0.94
Golden or Syrian hamster	0.46
Guinea pig	1.18
Hippopotamus	0.84
Horse	0.70
Human	0.73–3.13
Lion	2.12
Rat	0.79
Rhesus monkey	1.89
Walrus	1.36
Wolf	3.56
Birds	
Budgerigar	0.73
Carrion crow	1.19
Common buzzard	0.64
House sparrow	1.35
Hummingbird	1.37
Mallard	0.83
Ostrich	2.36
Pheasant	0.34
Rock dove	1.06
Stork	0.81
Swan	0.65

Table 1.8.2: Interior Lung Surface of Selected Animals

Figures represent mean values. Within a given class of vertebrates and among animals of the same size, those animals that move quickly are equipped with a larger lung surface.

Values after ALTMAN and DITTMER 1974, HALTENORTH 1977, KRUMBIEGEL 1953, ZISWILER 1976

Species	Interior lung surface (m ²)
Alligator	2.0
Bat (myotis)	0.5
Cat	20.0
Common or Harbor seal	65.0
Common toad	0.008
Dog	90.0
Dolphin	43.0
Fire salamander	0.0005
Horse	500.0
Human	90.0
Lungfish	0.016
Mouse	0.12
Rabbit	5.9
Rat	0.56
Sloth	5.0

Table 1.8.3: Breathing Rate and Single-Breath Air Volume of Selected Vertebrates

Data after BERTELSMANN 1979, Enzyklopädie 1979, KRUMBIEGEL 1953, MEYER 1964, OPPENHEIMER and PINCUSSEN 1925, PENZLIN 1977, ZISWILER 1976

Species	Breaths/min	Volume (cm ³)
Bat	50	
Buzzard/Hawk	20	
Capuchin monkey	46	
Carrion crow	25	
Cat	30	34
Cat shark	52	
Cattle	30	3,400
Chicken	27	31
Chimpanzee	19	
Common swift	90	
Dog	18	320
Duck	42	30
Electric rays	60	
Elephant	6	

(Cont.) →

Species	Breaths/min	Volume (cm ³)
Eurasian siskin	114	
European conger	48	
Fin whale	0.5	
Fox	24	
Giraffe	9	3,400
Golden or Syrian hamster	74	0.83
Gorilla	19	
Greater weever fish	26	
Guinea pig	90	1.75
Harbor porpoise	1.1	9,000
Hedgehog, awake	20	
Hedgehog, hibernating	5	
Horse	10	7,500
Human	11	500
Hummingbird	250 (!)	
Lion	10	
Lungfish (<i>Neoceratodus</i>)	28	15
Moray eel	26	
Mouse	163	0.15
Orca	1.1	46,200
Ostrich	3	
Painted comber (fish)	56	
Rabbit	37	21
Rat	85	0.86
Rock dove	30	4.7
Sheep	20	362
Shrew	120	
Sparrow	90	
Stork	8	
Wolf	14	

Table 1.8.4: Oxygen Consumption of Selected Animals

Figures in grams oxygen per kilogram body weight and hour. One gram of oxygen (O_2) corresponds to approx. 700 cm^3 . See also Table 1.4 and the comments found there on the relationship between oxygen consumption and body size.

Listed in systematic order.

Figures from SCHLIEPER 1952, VANGEROW 1975

Taxon, species	Body weight		Oxygen consumption (g O_2 per kg and h)
Paramecium	0.001	mg	0.7
Radiolaria (Protozoa)	0.1	mg	0.1
Cnidaria	10–100	g	0.004–0.02
Mussels	25–250	g	0.002–0.03
Snails	20–50	g	0.01–0.1
Cephalopods	10	g	0.6–0.32
Segmented worms (annelids)	1–20	g	0.03–0.7
Crustaceans	5–500	g	0.04–0.28
Echinoderms	10–600	g	0.018–0.04
Carp	200	g	0.08–0.3
Pike	200	g	0.49
Frog	30	g	0.03–0.09
			max. 0.63
Reptiles	30	g	0.02–0.03
Chicken	2	kg	0.79–1.1
Mouse (resting)	20	g	3.5
(running)			28
Rat (resting)	110	g	2.4
Dog (resting)	9	kg	0.72
Horse	400	kg	0.3
Human (resting)	70	kg	0.28
(working)			5.6

Table 1.8.5: Oxygen Consumption During Hibernation of Selected European Mammals

Figures represent oxygen consumption in cubic centimeters oxygen (O_2) per kilogram body weight (BW) and hour. For figures for nonhibernating animals, see Table 1.8.4. On hibernation, see also Table 1.4.5.

Data after ALTMAN and DITTMER 1972

Species	Oxygen consumption ($cm^3 O_2$ per kg BW and per hour)
Common pipistrelle	53
European ground squirrel (suslik)	15

(Cont.) →

Species	Oxygen consumption (cm ³ O ₂ per kg BW and per hour)
Fat dormouse	17–29
Giant noctule	30
Hamster	32
Hazel dormouse	40
Hedgehog	28
Long-eared bat	69
Marmot	18
Myotis (bat)	20

Table 1.8.6: Maximum Diving Depth and Diving Time of Air-Breathing Vertebrates

Figures from BRINK 1975, FRÄDRICH and FRÄDRICH 1973, GRZIMEK 1970, KRUMBIEGEL 1953, *Nat. Rdsch.*, NIETHAMMER 1979, PENZLIN 1970, SCHÄFER 1968, WOOD 1982, ZISWILER 1976

Species	Maximum diving time	Maximum depth
Alligator	120 min	
Beaked whale	120 min (!)	500 m
Beaver	15 min	
Blue whale	30 min	200 m
Bowhead whale	80 min	1,000 m
Common or Harbor seal	15 min	
Duck	15 min	
Elephant seal	30 min	100 m
Gray seal	18 min	146 m
Great cormorant	5 min	40 m
Great crested grebe	56 s	40 m
Guillemot	12 min	
Harbor porpoise		170 m
Hippopotamus	19 min	
Human	2 min	72 m
Leatherback turtle		1,200 m (!)
Loon	15 min	75 m
Muskrat	12 min	
Northern gannet		10 m
Penguins		60 m
Platypus	12 min	
Polar bear	2 min	
Sea otter		50 m
Sirenia (“sea cows”)	10 min	
Sperm whale	75 min	1,143 m
Walrus	10 min	30 m
Weddell seal	43 min	600 m