

# **Mensch in Zahlen**

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5 <http://de.wikibooks.org/wiki/Kategorie%3ABuch>  
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# 1 Der Körper im Allgemeinen

- Die Oberfläche eines erwachsenen Menschen beträgt etwa  $1,8\text{--}2\text{ m}^2$
- Ein erwachsener Mensch wiegt im Durchschnitt zwischen  $60\text{--}80\text{ kg}$  (Extreme:  $34\text{--}615\text{ kg}$ ). Die Höhe liegt bei  $175\text{ cm}$  (Extreme:  $59\text{--}272\text{ cm}$ )
- Das Volumen eines erwachsenen Menschen beträgt ungefähr  $0,075\text{ m}^3$ .
- Die Dichte eines normalen erwachsenen Menschen beträgt etwa  $1055\text{ kg}\cdot\text{m}^{-3}$ .<sup>1</sup>
- Das relative Gewicht der einzelnen Organe beträgt: Muskulatur<sup>2</sup>  $29\%$ , Haut<sup>3</sup>  $17,4\%$ , Skelett<sup>4</sup>  $11,6\%$ , Gehirn<sup>5</sup>  $2,3\%$ , Leber<sup>6</sup>  $2\%$ , Blutkörperchen<sup>7</sup>  $1,8\%$ , Lunge<sup>8</sup>  $1,6\%$ , Darm<sup>9</sup>  $1,4\%$ , Nieren<sup>10</sup>  $0,5\%$ , Herz<sup>11</sup>  $0,4\%$ , Milz<sup>12</sup>  $0,2\%$ , Bauchspeicheldrüse<sup>13</sup>  $0,1\%$ .
- Der erwachsene menschliche Körper besteht aus etwa  $10$  bis  $100$  Billionen Zellen<sup>14</sup> ( $10^{13}\text{--}10^{14}$ ). Nebeneinander aufgereiht ergeben sie eine Kette, die den Äquator über  $50$  mal umschlingen würde. Pro Stunde werden etwa  $1$  Mio neue Zellen gebildet. Eine andere Berechnung gibt  $6,25 \times 10^{13}$  Zellen an.
- Die durchschnittliche Zellgröße liegt zwischen  $10\text{--}20\text{ }\mu\text{m}$  (tausendstel mm).
- Zu den kleinsten Zellen gehören die Körnerzellen<sup>15</sup> der Kleinhirnrinde<sup>16</sup> ( $3\text{--}4\text{ }\mu\text{m}$ ), die Lymphozyten<sup>17</sup> ( $5\text{--}6\text{ }\mu\text{m}$ ) und die roten Blutkörperchen<sup>18</sup> ( $7,5\text{ }\mu\text{m}$  im Durchmesser)
- Die größte Zelle des menschlichen Körpers ist die Eizelle<sup>19</sup>  $0,1\text{--}0,2\text{ mm}$  im Durchmesser. Sie ist mit dem bloßen Auge gerade noch zu erkennen. Zu den "Zellriesen" zählen auch gewisse Nervenzellen, die, ihre Hauptverlängerung allerdings mitgerechnet, bis zu  $1,0\text{ m}$  Länge erreichen. Die Zellkörper der Neuronen<sup>20</sup> sind natürlich klein, sie liegen bei  $5\text{--}150\text{ }\mu\text{m}$ .
- Die Lebensdauer der Zellen ist verschieden, sie hängt von ihrer Aktivität ab.  $90\%$  unserer Körperzellen werden jährlich mindestens einmal gewechselt. Die roten Blutkörperchen leben  $120\text{--}130$

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1 Ziegelroth: Das spezifische Gewicht des menschlichen Körpers und Blutes — zugleich ein Beitrag zur Krasenlehre  
{<http://www.springerlink.com/content/n80m083098583j6q/>}, 1896

2 <http://de.wikipedia.org/wiki/Muskulatur>

3 <http://de.wikipedia.org/wiki/Haut>

4 <http://de.wikipedia.org/wiki/Skelett>

5 <http://de.wikipedia.org/wiki/Gehirn>

6 <http://de.wikipedia.org/wiki/Leber>

7 <http://de.wikipedia.org/wiki/Blut>

8 <http://de.wikipedia.org/wiki/Lunge>

9 <http://de.wikipedia.org/wiki/Darm>

10 <http://de.wikipedia.org/wiki/Niere>

11 <http://de.wikipedia.org/wiki/Herz>

12 <http://de.wikipedia.org/wiki/Milz>

13 <http://de.wikipedia.org/wiki/Bauchspeicheldr%FCse>

14 <http://de.wikipedia.org/wiki/Zelle%20%28Biologie%29>

15 <http://de.wikipedia.org/wiki/K%F6rnerzelle>

16 <http://de.wikipedia.org/wiki/Kleinhirn>

17 <http://de.wikipedia.org/wiki/Lymphozyt>

18 <http://de.wikipedia.org/wiki/rotes%20Blutk%F6rperchen>

19 <http://de.wikipedia.org/wiki/Eizelle>

20 <http://de.wikipedia.org/wiki/Neuron>

Tage, die Leberzellen 10–15 Tage, die weißen Blutkörperchen<sup>21</sup> 1–3 Tage. Die Schleimhautzellen des Dünndarms<sup>22</sup> 30–35 Stunden, also müssen etwa 74 % dieser Zellen täglich neu gebildet werden.

- Die Temperatur<sup>23</sup> des menschlichen Körpers liegt durchschnittlich bei 36,9 °C
- Von den über 100 bekannten elementaren Grundstoffen konnten im menschlichen Körper etwa 30 nachgewiesen werden: 10 sind im Prozentsatz von 99,9 vorhanden und heißen deshalb Makroelemente: Sauerstoff<sup>24</sup> 63 %, Kohlenstoff<sup>25</sup> 19 %, Wasserstoff<sup>26</sup> 9 %, Stickstoff<sup>27</sup> 5 %, Kalzium<sup>28</sup> 1 %, Phosphor<sup>29</sup> 0,7 %, Schwefel<sup>30</sup> 0,64 %, Natrium<sup>31</sup> 0,26 %, Kalium<sup>32</sup> 0,22 %, Chlor<sup>33</sup> 0,18 %, Die restlichen 0,1 % stellen die sogenannten Mikroelemente dar. Zu ihnen gehören Magnesium<sup>34</sup> 0,04 %, Eisen<sup>35</sup> 0,003 %, Fluor<sup>36</sup>, Selen<sup>37</sup>, Zink<sup>38</sup>, Zinn<sup>39</sup>, Kupfer<sup>40</sup>, Mangan<sup>41</sup>, Nickel<sup>42</sup>, Kobalt<sup>43</sup>, Bor<sup>44</sup>, Brom<sup>45</sup>, Jod<sup>46</sup> (nur 0,0003 %), Arsen<sup>47</sup>, Tellur<sup>48</sup>, Titan<sup>49</sup>, Molybdän<sup>50</sup>, Aluminium<sup>51</sup>, Gold<sup>52</sup> u.a. In Gramm ausgedrückt bei einem Menschen von 70 kg in abgerundeten Werten: Sauerstoff 44 kg, Kohlenstoff 14 kg, Wasserstoff 7 kg, Stickstoff 2,1 kg, Kalzium 1 kg, Phosphor 700 g, Kalium 170 g, Schwefel 140 g, Chlor 70 g, Natrium 70 g, Magnesium 30 g, Eisen 3 g Kupfer 300 mg, Mangan 100 mg Jod 30 mg.

Die geringe Menge dieser Elemente, manchmal können sie nur mittels spezieller Methoden (Atomabsorption, Massenspektrografie) nachgewiesen werden, sagt jedoch nichts über ihre Rolle, die sie im Organismus spielen, aus.

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21 <http://de.wikipedia.org/wiki/wei%DFes%20Blutk%F6rperchen>

22 <http://de.wikipedia.org/wiki/D%FCndarm>

23 <http://de.wikipedia.org/wiki/K%F6rpertemperatur>

24 <http://de.wikipedia.org/wiki/Sauerstoff>

25 <http://de.wikipedia.org/wiki/Kohlenstoff>

26 <http://de.wikipedia.org/wiki/Wasserstoff>

27 <http://de.wikipedia.org/wiki/Stickstoff>

28 <http://de.wikipedia.org/wiki/Kalzium>

29 <http://de.wikipedia.org/wiki/Phosphor>

30 <http://de.wikipedia.org/wiki/Schwefel>

31 <http://de.wikipedia.org/wiki/Natrium>

32 <http://de.wikipedia.org/wiki/Kalium>

33 <http://de.wikipedia.org/wiki/Chlor>

34 <http://de.wikipedia.org/wiki/Magnesium>

35 <http://de.wikipedia.org/wiki/Eisen>

36 <http://de.wikipedia.org/wiki/Fluor>

37 <http://de.wikipedia.org/wiki/Selen>

38 <http://de.wikipedia.org/wiki/Zink>

39 <http://de.wikipedia.org/wiki/Zinn>

40 <http://de.wikipedia.org/wiki/Kupfer>

41 <http://de.wikipedia.org/wiki/Mangan>

42 <http://de.wikipedia.org/wiki/Nickel>

43 <http://de.wikipedia.org/wiki/Kobalt>

44 <http://de.wikipedia.org/wiki/Bor>

45 <http://de.wikipedia.org/wiki/Brom>

46 <http://de.wikipedia.org/wiki/Jod>

47 <http://de.wikipedia.org/wiki/Arsen>

48 <http://de.wikipedia.org/wiki/Tellur>

49 <http://de.wikipedia.org/wiki/Titan>

50 <http://de.wikipedia.org/wiki/Molybd%E4n>

51 <http://de.wikipedia.org/wiki/Aluminium>

52 <http://de.wikipedia.org/wiki/Gold>

- Die chemischen Elemente<sup>53</sup> bilden im erwachsenen Organismus verschiedene Verbindungen, organische und anorganische, die in Prozenten ausgedrückt wie folgt vertreten sind:
  - Wasser<sup>54</sup> 60–70 %, Säuglinge<sup>55</sup> bis zu 75 %
  - Kohlenhydrate<sup>56</sup> 0,6 %
  - Eiweiß<sup>57</sup> 15 %
  - Fett<sup>58</sup> 10 %
  - Mineralsalze<sup>59</sup> 5 %
- Ein Erwachsener von 70 kg Körpermasse besteht demnach aus 46 Liter Wasser, 12 kg Eiweiß, 7,5 kg Fett, 0,7 kg Zucker und 3,8 kg verschiedene Salze
- Die verschiedenen Organe<sup>60</sup> unseres Körpers enthalten unterschiedliche Wassermengen so z.B. das Gehirn<sup>61</sup>: etwa 90 % der Organmasse, die Muskeln<sup>62</sup>: etwa 79 %, die Leber<sup>63</sup> etwa 70 % der Organmasse, Knochen<sup>64</sup>: etwa 20–44 % je nach dem Alter; Mittelwert: 32 %, Blut<sup>65</sup>: etwa 78 % der Masse; Zahnschmelz ist das wasserärmste Gewebe: 2 %;
- Die Haut<sup>66</sup> eines Erwachsenen hat eine Oberfläche von etwa 2 m<sup>2</sup> und ein Gewicht von etwa 4 kg. Rechnet man auch die Unterhaut mit ihren Fetteinlagen hinzu, wiegt die Haut 15–16 kg, was etwa 1/5 des Körpergewichts entspricht. Somit ist die Haut nach der Muskulatur das zweitschwerste Organ unseres Körpers;
- Auf die verschiedenen Körperabschnitte entfallen folgende Prozentsätze der Gesamtoberfläche der Haut: Rumpfvorderseite: 20 %, Rumpfrückseite: 18 % Ober- und Unterarm: 13 % Hand: 4,6 %, Ober und Unterschenkel: 32 %, Fuß: 6,4 %, Kopf: 6 %;
- 1 cm<sup>3</sup> Haut enthält: 6 000 000 Zellen, 25 Berührungspunkte, 13 Kältepunkte, 2 Wärmepunkte, 200 Schmerzpunkte, 10–25 Druckpunkte, 1 m Blutgefäße, 4 m Nerven, 100 Schweißdrüsen, 15 Talgdrüsen und 20–200 Haare (Durchschnitt für den gesamten Körper); (siehe zum Vergleich auch im Kapitel Sinnesorgane bei Tastsinn nach)
- Die Haut ist ein äußerst wichtiges Ausscheidungsorgan. Etwa 4 Millionen Schweißdrüsen<sup>67</sup> dienen der Wärmeregulation des Körpers. Die Schweißdrüsen sind recht ungleichmäßig verteilt. Die meisten kommen in der Hohlhand<sup>68</sup> und an der Unterseite des Fußes<sup>69</sup> vor: etwa 300–400/cm<sup>2</sup>. Die täglich abgesonderte Schweißmenge beträgt etwa 800 ml. Schwankungen sind verbunden mit äußerer Temperatur, physischen Anstrengungen, eingenommenen Flüssigkeiten, Nierentätigkeit<sup>70</sup> und Gesundheitszustand. Man verliert im Leben 19 kg tote Zellen.
- Das menschliche Haar<sup>71</sup> ist 0,07–0,18 mm dick (Schwankungen nach Farbe)

53 <http://de.wikipedia.org/wiki/Chemisches%20Element>

54 <http://de.wikipedia.org/wiki/Wasser>

55 <http://de.wikipedia.org/wiki/S%E4ugling>

56 <http://de.wikipedia.org/wiki/Kohlenhydrat>

57 <http://de.wikipedia.org/wiki/Eiwei%DF>

58 <http://de.wikipedia.org/wiki/Fett>

59 <http://de.wikipedia.org/wiki/Mineralstoff>

60 <http://de.wikipedia.org/wiki/Organ%20%28Biologie%29>

61 <http://de.wikipedia.org/wiki/Gehirn>

62 <http://de.wikipedia.org/wiki/Muskel>

63 <http://de.wikipedia.org/wiki/Leber>

64 <http://de.wikipedia.org/wiki/Knochen>

65 <http://de.wikipedia.org/wiki/Blut>

66 <http://de.wikipedia.org/wiki/Haut>

67 <http://de.wikipedia.org/wiki/Schwei%DF>

68 <http://de.wikipedia.org/wiki/Hand>

69 <http://de.wikipedia.org/wiki/Fu%DF>

70 <http://de.wikipedia.org/wiki/Niere>

71 <http://de.wikipedia.org/wiki/Haar>



- Die Zahl der Kopfhaare schwankt zwischen 88.000 und 150.000; sie ist von der Farbe abhängig. z.B. blondes Haar: 150.000, braunes Haar: 110.000 schwarzes Haar: 100 000, rotes Haar: 88 000. Täglicher Haarausfall: 40–120 Haare (Normalausfall). Ein Kopfhaar wächst pro Tag 0,2–0,3 mm, Zuwachs im ganzen Leben 50 m. Ein Barthaar 0,4–0,6 mm, Nasenhaare 2 m im Leben.
- Der tägliche Zuwachs eines Fingernagels<sup>72</sup> beträgt 0,086 mm, der eines Zehennagels, 0,05 mm. Die Fingernägel wachsen im Laufe des Lebens demnach um maximal  $[(365 \times 120) \times 0,086 = \text{ca. } 3800]$  4 Meter.
- Jeder Mensch beherbergt ca. 100 Billionen Bakterien. Sie sind ein notwendiger Teil des menschlichen Lebens geworden. Wir brauchen sie zum Überleben. So befinden sich auf der (sauberen) Hand ca. 200–1 000/cm<sup>2</sup>.

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<sup>72</sup> <http://de.wikipedia.org/wiki/Nagel%20%28Anatomie%29>

## 2 Der Bewegungsapparat

- Das menschliche Skelett<sup>1</sup> besteht aus 206 bzw. 210 Knochen<sup>2</sup>, deren Gesamtgewicht etwa 10 kg beträgt. Hinzu kommen 14–24 Sesamknochen<sup>3</sup> und 32 Zähne<sup>4</sup>. Die Knochen zeichnen sich durch eine beeindruckende Festigkeit aus. So hält z.B. der Oberschenkelknochen<sup>5</sup> eine Kraft von 15000 Newton<sup>6</sup> aus, das Schienbein<sup>7</sup> sogar eine Kraft von 16500 N. Ein Knochenspan von 1 mm Dicke hält eine Kraft von 150 N aus.
- Der Durchmesser schwankt zwischen 2,6–50 mm (Extreme: im Mittelohr<sup>8</sup>-Oberschenkelknochen)
- Der Mensch hat insgesamt 639 Muskeln<sup>9</sup>, davon etwa 400 Skelettmuskeln, deren Gewicht etwa 25–30 % des Körpergewichts entspricht. Die Kaumuskeln<sup>10</sup> entfalten eine bedeutende Kraft: im Schneidezahngebiet<sup>11</sup> etwa 200 N, im Backenzahngebiet<sup>12</sup> etwa 700–1000 N. Die Tagesgesamtleistung unserer Muskulatur beträgt etwa 3 Megajoule<sup>13</sup>, das entspricht der Arbeit eines Krans, der einen 6-Tonnen-LKW samt Anhänger 50 Meter hoch hebt.
- Dynamometrie<sup>14</sup>: Mann: mit dem rechten Arm 50 kg/m, mit dem linken Arm 40 kg/m; Frau mit dem rechten Arm 40 kg/m, mit dem linken Arm 30 kg/m
- Maximale Dauer-Fortbewegungsgeschwindigkeit ohne Hilfsmittel: 8 km/Stunde (Extrem 22,2 km/Stunde beim 10.000-Meter-Lauf<sup>15</sup>)
- Maximale Kurzzeit-Fortbewegungsgeschwindigkeit: fast 40 km/Stunde beim 100-Meter-Lauf<sup>16</sup>
- Bis zum zweiten Lebensjahr 150 km krabbeln, 22 Tsd. km gehen
- Die Knochen im menschlichen Körper bestehen zu 50% aus Wasser, aus 15,75% Fetten, zu 12,4% aus Knorpelmasse und 21,85% mineralischen Bestandteilen, davon ist der Großteil Kalzium.
- Die Wirbelsäule mit 33 Knochen besteht aus 7 Halswirbeln, 12 Brustwirbeln, 5 Lendenwirbeln, 5 Kreuzbeinwirbeln und 4 Steißbeinwirbeln (Das Steißbein kann auch aus 5 Wirbeln bestehen)
- Der Schultergürtel besteht aus 4 Knochen, 2 Schlüsselbeinen und 2 Schulterblättern
- Der Brustkorb besteht aus 12 Rippenpaaren, 1 Brustbein und den 12 Brustwirbeln. Es gibt 2 Arten von Rippen, 14 sternale Rippen die am Brustbein hängen und 10 asternale Rippen, von denen 6 am Rippenbogen ansetzten und 4 frei ohne Bindung an weiteren Rippen oder dem Brustbein hängen.

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1 <http://de.wikipedia.org/wiki/Skelett>  
2 <http://de.wikipedia.org/wiki/Knochen>  
3 <http://de.wikipedia.org/wiki/Sesambein>  
4 <http://de.wikipedia.org/wiki/Zahn>  
5 <http://de.wikipedia.org/wiki/Oberschenkel>  
6 <http://de.wikipedia.org/wiki/Newton>  
7 <http://de.wikipedia.org/wiki/Schienbein>  
8 <http://de.wikipedia.org/wiki/Mittelohr>  
9 <http://de.wikipedia.org/wiki/Muskel>  
10 <http://de.wikipedia.org/wiki/Kaumuskulatur>  
11 <http://de.wikipedia.org/wiki/Schneidezahn>  
12 <http://de.wikipedia.org/wiki/Backenzahn>  
13 <http://de.wikipedia.org/wiki/Joule>  
14 <http://de.wikipedia.org/wiki/Biomechanik>  
15 <http://de.wikipedia.org/wiki/10.000-Meter-Lauf>  
16 <http://de.wikipedia.org/wiki/100-Meter-Lauf>



### 3 Das Nervensystem

- In unserem Körper gibt es etwa 100 Milliarden Nervenzellen (Neuronen<sup>1</sup>). Davon befinden sich etwa 14 Milliarden im Gehirn<sup>2</sup> und davon wieder 9 bis 10 Milliarden in der Großhirnrinde<sup>3</sup>.
- Unser Gehirn wiegt zwischen 1350 und 1500 g (Gesamthirn). Davon entfallen auf das Großhirn<sup>4</sup> etwa 1188 g und das Kleinhirn<sup>5</sup> etwa 140–144 g, auf die übrigen Hirnteile das restliche Gewicht. Das Gehirn des Erwachsenen wiegt also etwa 1/33–1/44 des Körpergewichts. Absolut genommen haben Elefant<sup>6</sup> und Wal<sup>7</sup> ein schwereres Gehirn als der Mensch, doch nicht der absolute Wert ist entscheidend, sondern das Verhältnis des Gehirngewichts zum Körpergewicht. Einige Beispiele: Mensch 1/33–1/44, Schimpanse<sup>8</sup> 1/150, Hund<sup>9</sup> 1/500, Elefant 1/560, Wal 1/15 000, Arbeitsbiene<sup>10</sup> 1/175, Ameise<sup>11</sup> 1/280, Maikäfer<sup>12</sup> 1/3300.
- Nirgends im Tierreich ist gleichzeitig ein so hohes absolutes und ein so hohes relatives Hirngewicht vorhanden wie beim Menschen.
- Die Oberfläche der Großhirnrinde beträgt etwa 2200 cm<sup>2</sup>, das entspricht einem Quadrat von etwa 47 cm Seitenlänge. Die Dicke der Rinde beträgt 1,5–5 mm. Der Mensch hat die relativ dickste Großhirnrinde: etwa 80 % des gesamten Hirngewichts. (Zum Vergleich beim Pferd<sup>13</sup> etwa 67 %, beim Meerschweinchen<sup>14</sup> etwa 40 %).
- Die Großhirnrinde besteht aus 6 Zellschichten (Schwankungen je nach Hirnregion) und ist gefurcht. Hinsichtlich des Furchungsreichtums steht unser Gehirn jedoch erst an 5. Stelle (nach dem Elefanten, dem Tümmeler<sup>15</sup>, dem Schimpansen und dem Pferd. Zwischen dem Windungsreichtum der Rinde und dem Intelligenzgrad besteht augenscheinlich keine direkte Beziehung. Es gibt hochentwickelte Säuger mit furchenarmen Gehirnen (Hund) und tieferstehende Säuger mit furchenreichen Gehirnen (Schaf<sup>16</sup> und Esel<sup>17</sup>).
- Das Gewicht des Rückenmarkes<sup>18</sup> beträgt beim Menschen 2 % des Hirngewichts, bei den Antropomorphen 5 % und bei den übrigen Säugern 23–47 % des Hirngewichts.

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1 <http://de.wikipedia.org/wiki/Neuron>  
2 <http://de.wikipedia.org/wiki/Gehirn>  
3 <http://de.wikipedia.org/wiki/Gro%DFhirnrinde>  
4 <http://de.wikipedia.org/wiki/Gro%DFhirn>  
5 <http://de.wikipedia.org/wiki/Kleinhirn>  
6 <http://de.wikipedia.org/wiki/Elefant>  
7 <http://de.wikipedia.org/wiki/Wal>  
8 <http://de.wikipedia.org/wiki/Schimpanse>  
9 <http://de.wikipedia.org/wiki/Hund>  
10 <http://de.wikipedia.org/wiki/Biene>  
11 <http://de.wikipedia.org/wiki/Ameise>  
12 <http://de.wikipedia.org/wiki/Maik%E4fer>  
13 <http://de.wikipedia.org/wiki/Pferd>  
14 <http://de.wikipedia.org/wiki/Meerschweinchen>  
15 <http://de.wikipedia.org/wiki/T%Cmmler>  
16 <http://de.wikipedia.org/wiki/Schaf>  
17 <http://de.wikipedia.org/wiki/Esel>  
18 <http://de.wikipedia.org/wiki/R%Cckenmark>

- Das Gesamtgewicht unserer Nervenzellen beträgt etwa 21,5 g, eine mittelgroße Nervenzelle der Rinde wiegt 1/25 Tsd. mg
- Die Zahl der möglichen Verbindungen, welche die etwa 15 Milliarden Neuronen des Gehirns untereinander eingehen können, erreicht wahrhaft astronomische Werte. Infolge der sehr großen Zahl dieser möglichen Kombinationen stimmen 2 Menschen in ihren Gehirnleistungen niemals überein.
- Der Nervenimpuls wird zu den Nervenzellen (Axonen<sup>19</sup>) mit einer Geschwindigkeit von etwa 0,5–120 m/s weitergeleitet. Die Nervenimpulse haben eine Spannung von etwa 120 mV.
- Das Gedächtnis des Menschen kann nur 5–7 Argumente (Chunks<sup>20</sup>) im Kurzzeitgedächtnis speichern. Im Leben lernt man 2000 Menschen mit Namen kennen, mit 150 befreundet man sich für eine Zeit.
- Der Mensch braucht 7–12 Stunden Schlaf pro Tag (abhängig vom Alter), Extreme: durch Hirn-schäden Jahrzehnte ohne Schlaf.

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<sup>19</sup> <http://de.wikipedia.org/wiki/Axon>

<sup>20</sup> <http://de.wikipedia.org/wiki/Chunking>

# 4 Die Sinnesorgane

## 4.1 Sehsinn

- 90–95 % aller Sinneswahrnehmungen des Menschen sind optische Reize.
- sichtbares Licht im Spektrum der elektromagnetischen Strahlen: 390–760 nm
- es werden bei guten Lichtverhältnissen 1 Mio Farben unterschieden 10 Millionen Farbflächen, etwa 150 benennbare Farben erkannt.
- Lichtempfindlichkeit: Rekord: 5 Lichtquanten (-photonen), ein Blitz von 500 nm erkannt
- Normalsichtigkeit: 0,67–1, ein Mensch mit einer Augenhöhe von 2 m kann theoretisch 5,4 km weit sehen.
- Auflösungsvermögen 1/120 Bogengrade
- Brennweite der Linse: 69,9–40,4 mm (Vergleich Eule 250–500 mm, Frosch 5 mm)
- Sehschärfewinkel (minimum separabile): 25 Bogensekunden, bzw. 3–5 Winkelsekunden; Rekord: 0,85" (Vergleich Rhesusaffe: 34")
- Gesichtsfeld: 180°, (Scholle, Frosch 360°)
- Verschmelzungsfrequenz: 60 Bilder/sec = 60 Hz bei Tag ohne Bedeckung (Libelle 300 Bilder/sec)
- die Netzhaut (Retina) des Auges hat eine Oberfläche von 3,5 cm<sup>2</sup> und ist 0,1–0,4 mm dick. Sie ist das eigentliche Sehorgan, das aus etwa 132 Millionen Sehzellen besteht, davon etwa 125 Millionen „Stäbchen“ für das Schwarz-Weiß-Sehen und etwa 7 Millionen „Zäpfchen“ für das Bunt-Sehen. Der Sehnerv besteht aus etwa 1 Million isolierten Fasern
- der Druck in der Bindehaut-Arterie ist (4666±1333) Pa (entspricht (35±10) mm Quecksilbersäule).
- auf ultraviolette und infrarote Strahlen reagiert die Haut mit Bräunung bzw. Rötung/Blasen; für das Auge ist dieser Teil des Spektrums unsichtbar.
- Ionisierende Strahlen können eine verändernde Wirkung auf den Körper haben, in Abhängigkeit von der Dosis und davon, ob der ganze Körper oder nur ein Teil bestrahlt wurde, können gesundheitliche und u.U. auch tödliche Wirkungen, ggf. erst nach einiger Zeit, auftreten. Absolute Grenzwerte gibt es nicht.
- Ein Mensch schlägt seine Augenlider etwa 415 Mio. mal in seinem Leben.

## 4.2 Gehörsinn

- Mindestgröße des Reizes:  $8 \times 10^{-18} - 4 \times 10^{-17}$  Watt
- Differenzierungsvermögen:  $\frac{1}{4}$  Ton = 5 Hz, ein geübtes Gehör kann sogar Unterschiede von 1 Hz wahrnehmen
- Schallpegel: 0–170 dB, bei der Schmeißfliege 0,3–17.400
- geflüsterte Stimme wird bis 6–8 m gehört, Gespräch bis 20 m, Schreie bis 200 m. Rekord 17 km bei günstigen Bedingungen
- Hörfähigkeit: 16–21.000 Hz, (vom Alter abhängig), Fledermaus bis 400.000 Hz

- Hörschärfe (räumliches Auflösungsvermögen):  $8,4^\circ$  (kleinster Winkel bei dem 2 Schallquellen getrennt wahrgenommen werden), bei der Katze:  $1,5^\circ$
- Vibrationsschwelle bei 0,2 kHz optimale Frequenz: 1000 Hz
- das Cortische Organ (Innenohr) besitzt etwa 14 000 Hörzellen, die je 50 Sinneshärchen von 5 Mikron Länge aufweisen
- Die menschliche (Sing-)Stimme reicht von 65,41–523,25 Hz ( $C-c^2$ ) (Männer) bzw. von 150–1046,51 Hz ( $a-e^3$ ) (Frauen und Kinder). Sprechstimme  $130 \text{ Hz} \pm 10 \text{ Hz}$  (Männer),  $260 \text{ Hz} \pm 15 \text{ Hz}$  (Frauen und Kinder).
- Die Stimmstärke reicht von 5–130 dB (Extreme)
- Alle 2 Std wird bis zum 10. Lj ein neues Wort gelernt (= 43 800 Wörter)

### 4.3 Geschmacksinn

Differenzierung: es gibt 5 Geschmacksrichtungen

- süß (Saccharin): 0,001 g/l
- sauer (Salzsäure): 0,01 g/l
- salzig (NaCl): 1,0 g/l
- bitter (Chinin): 0,0004 g/l
- umami (Aminosäuren bzw. Glutamat)

Vermutlich gibt es weitere Geschmacksrezeptoren, die Fett gesondert wahrnehmen. Das geschmackliche Empfinden von Schärfe ist lediglich auf die Aktivierung von Schmerzrezeptoren zurückzuführen.

### 4.4 Geruchssinn

In 1 Liter Luft werden erkannt:

- $4 \times 10^{-9}$  (0,000 000 004) g Aceton
- $16 \times 10^{-12}$  (0,000 000 000 016) g Kampfer
- $500 \times 10^{-15}$  (0,000 000 000 000 5) g Vanillin
- $450 \times 10^{-15}$  (0,000 000 000 000 45) g Ethylmercaptan
- $350 \times 10^{-15}$  (0,000 000 000 000 35) g Skatol
- Differenzierungsvermögen: 1000 Gerüche Der Geruchssinn des Hundes übertrifft den des Menschen etwa 1000 mal
- Die Riechschleimhaut hat eine Oberfläche von etwa  $5 \text{ cm}^2$  und enthält etwa 10 Millionen Riechzellen und etwa 150 Schleimdrüsen.

### 4.5 Tastsinn

- Schwingungen von  $0,02 \mu\text{m}$  werden noch wahrgenommen
- in der Lederhaut gibt es: 40 000 Vater-Pacinische Tastkörperchen 40 000 Ruffinische Wärmekörperchen, 240 000 Krausesche Kältekörperchen 500 000 Meissnersche Tastkörperchen 60 Millionen Merkelsche Tastscheiben, und etwa 4 Millionen freie Nervenenden (Schmerzempfindung). Die Verteilung dieser Sinneskörperchen weicht in den verschiedenen Körperregionen ab.

# 5 Der Blutkreislauf

## 5.1 Blutmenge und Blutzellen

- ein Erwachsener hat zwischen 5–7 Liter Blut, das ist 1/12 der Körpermasse). Auf 1 mm<sup>3</sup> Blut entfallen etwa 5 Mio rote Blutkörperchen (beim Mann, bei der Frau etwa 4,5 Millionen), 5000–7000 weiße Blutkörperchen und etwa 300 000 Blutplättchen. In 5 Liter Blut gibt es somit etwa 25 Billionen rote Blutkörperchen und etwa 30 Milliarden Leukozyten. Erythrozyten besitzen einen Durchmesser von etwa 7,5 µm und sind etwa 2 µm hoch. Seitlich aneinandergereiht ergäben die roten Blutkörperchen eine Kette, die den Äquator etwa 5 mal umschlingen würde. Geldrollenartig gestapelt ergeben sie einen Stapel von etwa 60000 km. Die Gesamtoberfläche der roten Blutkörperchen beträgt etwa 3000 m<sup>2</sup>; täglich werden etwa 200 Mrd. rote Blutkörperchen produziert.

## 5.2 Masse

- das Herz, der "Motor ohne Ruhepause", ist ein faustgrosser Hohlmuskel, der eine Masse von etwa 280 g (Frau) – 310 g (Mann) hat;

## 5.3 Herzfrequenz

- das Herz des Erwachsenen schlägt etwa 70 mal pro Minute , etwa 4200 mal pro Stunde , etwa 100 000 mal pro Tag , etwa 37 Mio. mal pro Jahr und etwa 2,6 Milliarden mal in einem 70jährigen Leben . Frauenherzen schlagen im Durchschnitt etwas schneller als Männerherzen. Bei ausdauertrainierten Frauen und untrainierten Männern kann es auch umgekehrt sein.

## 5.4 Schlagvolumen und Pumpleistung

- bei jedem Schlag (Dauer: 0,8 Sekunden) pumpt das Herz (linke Herzkammer mit arteriellem Blut) in Ruhe etwa 70 ml Blut in den Körperkreislauf (Schlagvolumen). Das sind bei 70 Schlägen/Minute: pro Min. 4,9 Liter Blut (gerundet: 5 l), pro Stunde 294 Liter, pro Tag 7.056 Liter, in einem Jahr 2.575.440 Liter, in einem Menschenleben von 80 Jahren sind das 210.240.000 Liter Blut.
- bei starken Anforderungen kann das Herz die 5-fache Blutmenge umwälzen, wobei die Steigerung zur Hauptsache von der erhöhten Schlagfrequenz herrührt.



## 5.5 Leistung

- die Arbeitsleistung des Herzens ist dementsprechend groß. Um ein Schlagvolumen in den Kreislauf zu pumpen, leistet das Herz eine Arbeit von 1/5 Meterkilopond. Das entspricht einer Arbeit von 20 000 Meterkilopond/Tag, Die etwa 180 Millionen Liter Blut, die in einem 70jährigen Leben gepumpt werden, würden einen Tankwaggenzug mit etwa 10000 Waggonen füllen;

## 5.6 Kapillaren

- die Blutkapillaren haben einen Durchmesser von 5–25 Mikrometer und eine Länge von 0,5–4 mm. Hintereinander geschaltet erhielte man ein Rohr von etwa 160 000 km Länge was etwa 1/2 der kleinsten Entfernung Erde–Mond entspricht. Die Oberfläche der Kapillaren zusammengenommen beträgt etwa 6000–7000 m<sup>2</sup>

## 5.7 Blutflußgeschwindigkeit

- Das Blut benötigt etwa 1 Minute um den kompletten Körper einmal zu durchqueren. Diese Menge ist gleich dem Herzminutenvolumen, also dem Blutvolumen, das in einer Minute vom Herzen ausgeworfen wird. Es entspricht in etwa der Blutmenge im Körper: ca. 6 Liter.
- das Blut kreist in den Blutgefäßen mit folgenden Durchschnittsgeschwindigkeiten: Aorta und große Arterien. 20–50 cm/sec, kleine Arterien 5,6–5,8 cm/sec; Arteriolen: 0,28–0,30 cm/sec, Kapillaren: 0,03–0,05 cm/sec, Venen 2 cm/sec.

## 5.8 Blutdruck

- der Blutdruck beträgt in Ruhe etwa 120 mm Hg systolisch ( in der Herzauswurfphase) und 80 mm Hg diastolisch ( in der Herzfüllungsphase ). Durch die Elastizität der Schlagadern sinkt der Blutdruck diastolisch nicht auf Null ab. Unter starker körperlicher Belastung steigt der Blutdruck bis auf 200 / 100 mm Hg an.

## 6 Der Verdauungsapparat

- die 6 großen Mundspeicheldrüsen sondern täglich 1–2 Liter Speichel ab. Die Menge des abgesonderten Speichels ist unter anderem von den Speisen abhängig, die wir im gegebenen Moment zu uns nehmen. Im Leben werden etwa 50 t Speichel produziert
- der Magen kann bis zu 3 Liter fassen. Verschiedene Speisen verbleiben hier verschieden lang, Beispiele: Flüssigkeiten: meist nur einige Minuten; Reis: 1,5 Stunden, Gemüse, Brot, weiche Eier: etwa 3 Stunden; gebratenes Fleisch: 4–6 Stunden; sehr fettes Fleisch und Ölsardinen 8 Stunden und noch mehr. Etwa 35 Millionen Drüsen der Magenschleimhaut sondern täglich 1–2 Liter Magensaft ab.
- Der Dünndarm misst etwa 5 m Länge . Seine vielen Millionen Drüsen sondern pro Tag etwa 3 Liter Verdauungssaft ab.
- Die Oberfläche der Dünndarmschleimhaut wird durch etwa 6–7 Millionen Darmzotten ungemein stark vergrößert: etwa 40 m<sup>2</sup> . Diese Riesenfläche gewährleistet die sogenannte Darmabsorption der verdauten Nährstoffe.
- Die Leber wiegt etwa 1,5 kg und besteht aus etwa 1 Million Läppchen. Sie ist das größte Drüsenorgan des Körpers;
- der Speisebrei durchwandert den Dickdarm in 7–10 Stunden, wobei etwa 80 % der etwa 8 Liter Wasser, die täglich in die Verdauungswege abgegeben werden, wieder in den Körper zurückkehren;
- ein Erwachsener verdaut pro Jahr etwa das 7fache, im Laufe eines 75 jährigen Lebens etwa das 500-fache des eigenen Körpergewichts an Nahrung
- Ein Durchschnitts-Europäer verzehrt in 70 Jahren folgende Mengen an Nahrungsmitteln: 30 Tonnen Kartoffeln, 25 Tonnen Brot, 18 Tonnen Fleischwaren, 15 Tonnen Gemüse, 10 Tonnen Früchte, 5 Tonnen Fisch, 25 000 Liter verschiedene Getränke (Milch, Bier usw.) 160 kg Schokolade, 7300 Eier, 84 kg Salz.
- Ohne zu essen kann der Mensch bis zu 40 Tage leben, ohne zu trinken nur 3–6 Tage.



## 7 Der Atmungsapparat

- das absolute Gewicht der Lungen beträgt etwa 1300 g. Die Differenz bei Mann und Frau ist maximal 200 g.
- Die Atemluft besteht zu 78% aus Stickstoff und zu 20,8% aus Sauerstoff, der Rest sind Kohlendioxid (0,03%, durch Verbrennungsvorgänge mittlerweile 0,038%) und andere Gase (Edelgase, Kohlenmonoxid).
- die Zahl der kleinen Bronchien beträgt etwa 230 000, die Zahl der Lungenbläschen (Alvöolen) liegt zwischen 300 und 450 Millionen. Sie ergeben eine Atmungsfläche von 90–150 m<sup>2</sup>. Die Alveolarkapillaren ergeben eine Fläche von etwa 140 m<sup>2</sup>;
- bei einem gewöhnlichen Atemzug werden etwa 500 cm<sup>3</sup> Luft in die Lungen eingesogen. (= Atem- oder Respirationsluft).
- Nach normaler Einatmung können weitere 1500 cm<sup>3</sup> Luft, durch angestregtes Einatmen in die Lungen eingesogen werden (= Komplementärluft). Desgleichen können nach normaler Ausatmung durch höchste Anstrengung noch etwa 1500 cm<sup>3</sup> Luft ausgeatmet werden (= expiratorisches Reservevolumen). Die genannten Volumina ergeben die so genannte Vitalkapazität der Lungen. Sie beträgt also im Durchschnitt 3500 cm<sup>3</sup>. Nach maximalen Ausatmen verbleiben immer noch 1500 cm<sup>3</sup> Luft in der Lunge (= Residualvolumen). Zusammen mit der Vitalkapazität ergibt sich das gesamte Lungenvolumen zu 5000 cm<sup>3</sup> (= Totalkapazität). Schwankungen sind jedoch häufig.
- die Zahl der Atemzüge: etwa 16/Minute. Dabei werden 10 Liter Luft/Minute ein- bzw. ausgeatmet. Die Tagesleistung der Atemmuskulatur beträgt ca. 25 kNm (KiloNewtonmeter); Bis zum 21. Lj. Wird die Luft von 3,5 Mio Luftballons eingeatmet.
- Die sich nach dem maximalen Einatmen in den Lungen befindliche Luft reicht bei einem gesunden Erwachsenen in Ruhe etwa 5min aus um das Gewebe mit Sauerstoff zu versorgen. Allerdings setzt nach dem Ausatmen in 20 Sekunden ein starker Atemreiz ein, nach dem Einatmen in 60 Sekunden. Manche Perlentaucher bleiben bis zu 4–6 min unter Wasser, der Rekord liegt bei über 15 min.
- pro Minute werden die Lungen von etwa 6 Liter Blut durchströmt. Dabei nehmen sie etwa 300 ml Sauerstoff auf;



## 8 Der Ausscheidungsapparat

- die Nieren wiegen durchschnittlich je 130 g und haben ein Volumen von etwa 120 cm<sup>3</sup>;
- die Struktur- und Funktionseinheiten der Nieren sind die Nierenkanälchen (Nephron), von denen es etwa 1 Million/Niere gibt. Sie haben eine Länge von je 40 mm (im Durchschnitt). Aneinandergereiht ergäben sie ein Röhrchen von 80–100 km Länge. In den Nierenkanälchen wird der Harn gebildet;
- die Nieren werden täglich von etwa 1508 Liter Blut durchströmt. Dabei treten in den Nierenkörperchen der Nephronen etwa 191 Liter eiweißloses Blutplasma aus den Nierenarteriolen in das Nephron über (Primärharn). Beim Durchströmen der Nierenkanälchen werden aus dem Primärharn etwa 178,5 Liter Wasser rücksorbiert (zusammen mit verschiedenen Salzen und Glukose). Was übrig bleibt, ist der konzentrierte Harn, etwa 1–1,5 Liter/24 Stunden, der ausgeschieden wird. Die Menge des täglich ausgeschiedenen Harns ist von verschiedenen Faktoren abhängig, wie: Gesundheitszustand, Wasserzufuhr, Arbeitsregime, äußere Temperatur. Zuckerkrankte scheiden täglich mehrere Liter Harn aus; im Diabetes insipidus sind es sogar bis zu 30 Liter täglich. Im Laufe des Lebens produzieren die Nieren etwa 40.000 l Urin.
- Wasser wird auch durch die Haut (etwa 450 ml/Tag), durch die Lungen (etwa 550 ml/Tag) und durch den Kot (etwa 150 ml/Tag) abgegeben;



## 9 Der Fortpflanzungsapparat

- Die Normalmaße des männlichen Fortpflanzungsorgans, des Penis, werden zwischen 7,25–11,5 cm in schlaffem Zustand und mit 12–19 cm in erigiertem Zustand angegeben. Extreme 1–44,5 cm (?? beide krankhafte Erscheinungen). Der Kamasutra kennt drei Größen des typisch männlichen Organs: "Hengst" (18–25 cm), "Stier" (16–18cm) und "Hase" (13–15, 5 cm). Der Umfang variiert im erigierten Zustand zwischen 8,5–12 cm. Eine in 1970 durchgeführte Studie ergab, dass der längste Penis 23.75 cm (im erregten Zustand!) betrug. In einer früheren, multikulturellen Studie, wurden allerdings andere Längen erfasst: fast 30.5 cm!
- Der größte Busen wird mit 220 cm Brustumfang und einem Gewicht von etwa 50 kg angegeben (Bertha Drews).
- Der Orgasmus dauert normalerweise 5–7 Sekunden. Extreme: mehr als 30 Sekunden (bei einer Frau).
- Im Durchschnitt hat der Mensch 2.580 mal Sex mit 5 verschiedenen Partnern, ist 2 mal verliebt
- die menschliche Samenzelle wiegt etwa 2 milliardstel Gramm, die Eizelle wiegt etwa 8,5 Milligramm. Die befruchtete Eizelle wiegt etwa 20 mg. Der Embryo von 2 Monaten wiegt 1 g, das Kind bei der Geburt etwa 3,5 kg, d.h, das 175.000 fache von den 20 mg der Anfangsmasse. In den 9 Monaten der Schwangerschaft werden aus der befruchteten Eizelle etwa 3 Billionen Zellen. Vergleicht man 1 Zelle mit einem Haus, dann ähnelt das Embryonalwachstum der Entstehung und Vergrößerung einer Siedlung. Nach 9 Monaten wäre statt einem Haus eine Mammutstadt vorhanden, die etwa 10mal größer wäre als alle Städte und Dörfer der Welt zusammengenommen.





# 10 Die Zeit

## 10.1 Lebenserwartung

- Die durchschnittliche Lebensdauer des Menschen liegt weltweit bei 73 Jahren, Frauen leben durchschnittlich 5 Jahre länger als Männer. Rekord: 122 Jahre (Jeanne Calment<sup>1</sup>)

Lebenserwartung in Westeuropa bei Frauen 79 j, Amerika 80, Afrika 55.

- Mittlere Lebenserwartung in der Bundesrepublik Deutschland
  - Frauen 82 Jahre
  - Männer 77 Jahre
  - Raucher 8 Jahre weniger

## 10.2 ... und womit die Zeit verbracht wird

25 Jahre schlafen und

- 4.000 × Sex

3,5 Jahre essen und trinken

- 45,5 Schweine
- 3,2 Rinder
- 5,1 Ziegen
- 926 Hühner
- 16.269 Eier
- 6.921 l Milch
- 5.192 Brote
- 5.000 kg Kartoffeln
- 8.028 Äpfel
- 6.859 Möhren
- 3.367 Schokoladentafeln
- 4.049 Riegel
- 11.586 l Kaffee
- 8.857 l Bier
- 1.881 l Wein
- 88.287 Zigaretten

6 Monate auf der Toilette

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<sup>1</sup> [http://de.wikipedia.org/wiki/Jeanne\\_Calment](http://de.wikipedia.org/wiki/Jeanne_Calment)

- 2.900 kg Ausscheidungen
- 3.651 Rollen Toilettenpapier

12 Jahre reden, 2 Jahre telefonieren

- 461.782.349 Worte (bei 16.000 Worten täglich)

12 Jahre fernsehen

- 6 Fernsehgeräte

2 Jahre Auto o. Ä. fahren, 6 Monate im Stau stehen

- 9,8 Autos
- 44.820 l Kraftstoff
- 819.214 km Autofahrt
- 4 Fahrräder
- 25.160 km Fußweg

8 Jahre arbeiten, 2 Wochen küssen

Dabei werden insgesamt hinterlassen

- 35.800 kg Müll
  - 3.796 Windeln
  - 8.000 kg Verpackungen für Lebensmittel

### **Wie verbringen wir unsere Zeit?**

Einer Studie von *Geo Wissen* (36/2005) zufolge verbringt der „ganz durchschnittliche Deutsche“ seine (Lebens-)Zeit folgendermaßen:

- 24 JAHRE UND 4 MONATE schläft der Mensch
- 7 JAHRE arbeitet er
- 5 JAHRE wendet er fürs Essen auf
- 2 JAHRE UND 10 MONATE verplaudert, vertratscht und verscherzt er
- 2 JAHRE UND 6 MONATE verbringt der Deutsche im Auto
- 2 JAHRE UND 2 MONATE kocht er oder schmiert Brote
- 1 JAHR UND 10 MONATE lernt er und bildet sich fort
- 1 JAHR UND 7 MONATE betätigt er sich sportlich
- 16 MONATE putzt er seine Wohnung
- 12 MONATE geht der Deutsche ins Kino, Theater oder zu Konzerten
- 9 MONATE verbringt er auf dem Weg zur Arbeit
- 9 MONATE wäscht und bügelt der Deutsche
- 9 MONATE spielt er mit seinen Kindern
- 6 MONATE sitzt er auf der Toilette
- 6 MONATE steht der Deutsche im Stau
- 5 MONATE setzt er seine Wohnung instand
- 4 MONATE spielt er am Computer
- 3 MONATE nimmt er an Vereinssitzungen teil
- 3 MONATE vertreibt er sich die Zeit in Kneipen
- 3 MONATE bringt der Deutsche beim Arzt zu
- 12 WOCHEN betätigt er sich beim Vorspiel
- 2 WOCHEN küsst er

- 2 WOCHEN betet er
- 17 TAGE geht der Deutsche jagen, fischen und sammeln und
- 16 STUNDEN erlebt er den sexuellen Höhepunkt



## 11 Quellen



## 12 Autoren

<b>Edits</b>	<b>User</b>
2	4tilden <sup>1</sup>
1	C64 <sup>2</sup>
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3	ThePacker <sup>19</sup>
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1	Uwe a <sup>21</sup>

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1 <http://de.wikibooks.org/w/index.php?title=Benutzer:4tilden>  
2 <http://de.wikibooks.org/w/index.php?title=Benutzer:C64>  
3 [http://de.wikibooks.org/w/index.php?title=Benutzer:Dirk\\_Huenniger](http://de.wikibooks.org/w/index.php?title=Benutzer:Dirk_Huenniger)  
4 <http://de.wikibooks.org/w/index.php?title=Benutzer:Dr-nick>  
5 <http://de.wikibooks.org/w/index.php?title=Benutzer:E%5E%28nix%29>  
6 <http://de.wikibooks.org/w/index.php?title=Benutzer:Geitost>  
7 <http://de.wikibooks.org/w/index.php?title=Benutzer:Haeber>  
8 <http://de.wikibooks.org/w/index.php?title=Benutzer:Heuler06>  
9 <http://de.wikibooks.org/w/index.php?title=Benutzer:Juetho>  
10 <http://de.wikibooks.org/w/index.php?title=Benutzer:Klartext>  
11 [http://de.wikibooks.org/w/index.php?title=Benutzer:Klaus\\_Eifert](http://de.wikibooks.org/w/index.php?title=Benutzer:Klaus_Eifert)  
12 <http://de.wikibooks.org/w/index.php?title=Benutzer:Klausmach>  
13 <http://de.wikibooks.org/w/index.php?title=Benutzer:MichaelFrey>  
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