The making of me and you: sources and methodology

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GENERAL NOTES

1. All results reflect the information you have entered and do not take into account your specific genes, environment and lifestyle.
2. All calculations have been carried out in metric units. If you have selected to see results in imperial UK or imperial US units, we have applied conversion rates.
3. We asked you for your “weight” in the graphic to refer colloquially to your mass. For the purpose of this document we refer only to mass.

BODY SHOP

<table>
<thead>
<tr>
<th>INGREDIENTS OF ME</th>
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<tbody>
<tr>
<td><strong>Your data used</strong> Mass</td>
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</table>

**How we worked this out**
We multiplied your body mass by the abundance of each chemical element in the human body by mass to find the approximate mass of each element within you.
We then multiplied this figure by the price of each element per kilogram to find how much each element within you is worth, and added up the values to calculate your total price tag. More than 40% of this is down to a single element – hydrogen.

We used the prices for pure, laboratory-grade elements. Since most elements in your body are found in tiny amounts, it would not be worth trying to extract them – the costs of extraction and purification would likely outweigh any profit made.

**Sources**
We took the average (mean) of price and abundance data from several sources.

Elemental abundance by mass:
- Random Science Tools and Calculators

Price per kg:
- Datagenetics
- Chemicool

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**DIGGING FOR GOLD**

**Your data used** Mass

**How we worked this out**
We multiplied your body mass by the abundance of each chemical element in the human body by mass to find the approximate mass of each element within you.

We worked out how many of ‘you’ it would take to make 1g of each trace element with the following calculation:

\[
100 \div \text{mass of each element in your body (see above)}
\]

How much arsenic it would take to kill you was based on it taking between 0.002% and 0.0002% of your body mass.

**Sources**
We used abundance data from several sources and took the average (mean).

Elemental abundance by mass:
- Random Science Tools and Calculators

Amount of...
- Arsenic to kill you: ChemSee
- Mercury in a thermometer: US Environmental Protection Agency
- Silver in an Olympic silver medal: Forbes
- Gold in the earth’s crust: PeriodicTable.com, WebElements
- Uranium in the sea: World Nuclear Association
MATCHMAKER

Your data used Mass

How we worked this out
We multiplied your body mass by the abundance of each chemical element in the human body by mass to find the approximate mass of each element within you.

We then calculated the amount, in grams, of each element in an object: iron in a nail, sodium in a teaspoon of salt, and so on. We used published sources to derive the typical concentrations of each element and made assumptions about the size of each object.

Dividing the amount of each element in your body by the amount in each object gives the number of objects you could make with the element in your body.

Iron: Nails come in various sizes. Here we assume the nail contains 6g iron.

Chlorine: We took an Olympic swimming pool to be 50m long, 25m wide and 2m deep (volume $2,500m^3$) Chlorine concentration 1mg/litre.

Sodium: One teaspoon of table salt is around 2,300mg or 2.3g sodium.

Potassium: One medium banana contains around 422mg potassium per 118g fruit.

Phosphorus: Boxes of matches include the striking surface (friction panel) as well as match heads. Assuming friction panel dimensions of 110mm x 20mm (Cook's matches, measured), area 2,200 mm$^2$, 2 panels per matchbox, 0.03mg/mm$^2$ red phosphorus = 132mg on outside of each box. Approx. 250 matches per box. Most of the phosphorus is in the box rather than the match heads. Typical safety matches: 20 mg of composition per safety match head, 1-1.2% red amorphous phosphorus. i.e. 0.2mg per match.

Sources
Iron: Total Materia
Chlorine: Lenntech, FINA
Sodium: American Heart Association
Potassium: Healthalicious
Phosphorus: Republic Technologies, Compound Interest

ATOMIC THEORY

Your data used Mass

How we worked this out
We divided your mass in kilograms by 10 to give an approximate number of atoms in your body in octillions (one octillion = one followed by 27 zeros or $10^{27}$) Why? There are around $7 \times 10^{27}$ atoms in the body of a 70kg adult – or $10^{26}$ atoms per kilogram of body mass.

Taking the compressed density of an atom to be average nuclear density, or around $2.3 \times 10^{17}$kg/m$^3$, a 10kg person at nuclear density would have a volume of 43µm$^3$, a 70kg person 304µm$^3$ and a 150kg person 652µm$^3$. 
The volume of an average normal red blood cell is around 90 femtolitres (1 femtolitre = $10^{-15}$ litres), or about 90µm$^3$.

So most people compressed to nuclear density will be within an order of magnitude of the volume of a red blood cell – although normally on the larger side.

**Sources**
Atoms in 70kg male: Freitas 1998
Nuclear density: Wikipedia, Mittal: Introduction to Nuclear and Particle Physics, Serway: Physics for Scientists and Engineers
Human body density: approximation based on Krzywicki et al 1966
Volume of red blood cell (mean corpuscular volume): NIH Medline Plus

**BODY COUNT**

**MINI ME**

**Your data used** Mass

**How we worked this out**
The number of cells in your body is tricky to calculate and even harder to count, so this one’s pretty approximate. All we can really say is that the true number probably lies between 10 trillion and 100 trillion, based on the spread of existing estimates.

Here we simply calculated the number of cells in your body as your mass in kilograms divided by 2, multiplied by a trillion. Why?

A 2013 study (Bianconi et al) scoured the scientific literature, took the average of the cell counts cited for each different type of cell, then added them all up. It came up with a figure of 37 trillion for a person weighing 70kg. Another published estimate used an entirely different method to calculate this 70kg ‘reference human’ would have around 35 trillion cells. Pretty close. We know that the larger you are, the more cells you will tend to have. So if a 70kg person has around 35 trillion cells, then let’s assume a 100kg person has around 50 trillion, and a 150kg person has 75 trillion. Spot the pattern? Yes, we’re guesstimating here. In reality, it’s unlikely the relationship between body mass and cell count is 1:1 because cells come in different sizes. (Fat cells, for example, can be much larger than other types of cell so if you have a high percentage of body fat, you may well have fewer cells than this simple equation would predict.)

We then applied the breakdown of cells by tissue type from Bianconi et al to this rough total to get a number in trillions for cells of each tissue type. Over 70% of your cells are red blood cells! Each red blood cell is microscopic – only around 8 micrometres long – but there are so many of them that laid lengthways end to end they would reach many kilometres into space.

Be aware that these numbers refer only to human cells – your bacterial cells are covered in Fellow Travellers.

**Sources**
Stars in Milky Way (estimated): Space.com
Trees on Earth (estimated): Crowther et al 2015
**SWEAT THE SMALL STUFF**

**Your data used** Height, Mass

**How we worked this out**

You were born with all the hair follicles you will ever have – approximately 5 million. They simply move further apart as your body grows, but do not regenerate. This is why baldness is so hard to treat. (Ironically, one way to stimulate follicle growth is to *pluck the hair out*.)

You have around 200 sweat glands for every 1cm² of skin, so we calculated the total number of sweat glands from your skin surface area. There are around 125,000 glands on each foot, so 250,000 on both feet. (This figure is very approximate and likely does not apply well to smaller people, so if you are less than 120cm tall, we excluded it from the visualisation.) For palms, we assumed 571 glands per cm² (the average of measured values from four studies) and a hand surface area of 76cm² (average for Indian adult males and females). Larger or smaller palms may have more or less than this, and all values are, as always, approximate.

Sweat glands per cm² by body part are the average of measured values from four separate studies.

**Sources**

Total number of hair follicles: WebMD, io9
Follicles on scalp, eyelashes and eyebrows: Flindt 2006, Amazing numbers in biology, via Bionumbers
Hair follicle density by body site: Otberg et al 2004
Average sweat gland density / number of sweat glands, whole body: Wilke et al 2007, Taylor and Machado-Moreira 2013
Sweat glands on feet: College of Podiatrists
Palm sweat gland density: Taylor and Machado-Moreira 2013
Palm surface area: Agarwal and Sahu 2010
Sweat gland density by body site: Wilke et al 2007

**FELLOW TRAVELLERS**

**Your data used** Age, Sex, Mass

**How we worked this out**

The number of cells in your body is calculated using the method described in Mini Me, based on your body mass.

Estimates of the number of microbial cells in the human body vary, but there are probably around 100 trillion – so it’s very likely that more of your cells are bacterial than human. (It’s become a popular meme that bacterial cells outnumber ours by 10 to one but there’s *no robust evidence for this particular figure* and it’s based on an estimate of 10 trillion human cells, which is on the low side.) They make up around 1-3% of your body mass – here we assumed an average of 2% – and play an important role in everything from digestion to fighting disease. They may even *affect your mood*.
You have around 20,000 protein-coding genes (we excluded your 10,000 other genes here), compared to the approximately 2 million unique bacterial genes in your microbiome. So their genes outnumber yours by a mighty 10,000 to one.

What’s more, these microbial communities are distinct to you – although the other members of your household will have similar communities.

Brain and liver mass are calculated using the method described in Pounds of Flesh, based on your age, sex and mass.

<table>
<thead>
<tr>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbial cells, estimated: <a href="#">Savage et al 1977</a>, widely cited elsewhere</td>
</tr>
<tr>
<td>Microbiome makes up 1-3% of body mass, c.10,000 species: <a href="#">NIH Human Microbiome Project</a></td>
</tr>
<tr>
<td>20,000 protein-coding genes: <a href="#">Human Genome Project Information Archive</a></td>
</tr>
<tr>
<td>Microbial genes per individual human: <a href="#">New York Times</a></td>
</tr>
<tr>
<td>Gut bacteria species composition depends mainly on diet: <a href="#">Nature Scitable</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HUMAN HARD DRIVE</th>
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<tr>
<td>Your data used None</td>
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</table>

**How we worked this out**

**Organic**

Base pairs are the chemical building blocks of DNA. They are made of pairs of chemicals that bond with each other: adenine (A) with thymine (T) and cytosine (C) with guanine (G). The amount of data stored in the genome of each living organism is calculated as 0.25 bytes per base pair multiplied by the number of base pairs per genome. There are around 3.2 billion base pairs in the human genome, so the data stored is 0.25 x 3.2 billion bytes, or about 800 megabytes (MB).

Why 0.25 bytes? The smallest unit of computer memory is a bit, which is a single binary unit of memory: either a 1 or a 0. Each point in the genome can have one of four bases in it (A, T, C or G), so it takes two bits to encode each point: two 1/0 choices gives you four possibilities in all (00, 01, 10, 11). A byte is defined as 8 bits (it wasn’t originally but the 8-bit definition has stuck), so the 2 bits we need to encode each base is 0.25 bytes.

The elephant is the African elephant, *Loxodonta africana*.

**Digital**

Simply the data stored in each digital medium. We use decimal rather than binary definitions, so a 1 gigabyte (GB) USB stick = 1000 MB, and not 1024 MB. The value for the single-page text document is approximate. 4.7 gigabytes is standard for a single-sided, single-layer DVD.

**Sperm produced in lifetime**

The genetic information is copied across sperm cells and is not unique data. Around 1500 sperm are produced per second!
Approximately 3.1 billion base pairs per sperm cell (fewer than full human genome because sperm can have either an X or Y chromosome but not both) x 0.25 bytes per base pair = 775 MB data per sperm.

Average male life expectancy at birth, globally: 66.7 years. Average age of puberty, males: 12 years. Average male fertile lifespan: 66.7 – 12 = 54.7 years. This will vary considerably between individuals.

Sperm produced per lifetime: 1500 per second x 60 x 60 x 24 x 365.25 x 54.7 = 2.589 trillion = 2.6 trillion. This figure does not take into account any drop off in sperm production with age.

2.6 trillion x 775 megabytes of data per sperm cell = 2007 exabytes or just over two zettabytes (ZB). This is 2 billion terabytes.

Global internet traffic 2015: 72,426 petabytes (PB) per month x 12 months = 869,112 PB = 0.9 ZB per year. This is 900 million terabytes.

**Eggs produced in lifetime**
The genetic information is copied across egg cells and is not unique data.

Approximately 3.1 billion base pairs per egg cell (fewer than full human genome because eggs have only X chromosomes) x 0.25 bytes per base pair = 775 MB data per egg.

Ovulations per lifetime: around 400 on average. This is a rough average and will vary between individuals.

Genetic information (duplicated data) in eggs shed over lifespan = 400 eggs x 0.775 GB per egg - 310 GB.

Girls, average episode length: 30 minutes = 12.1 GB at 1920 x 1080, 24fps, Blu-ray quality.

310 GB / 12.1 GB per episode = 25.6 episodes of Girls, which rounds to 26 episodes.

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**Sources**
- Human genome size: [Genome Reference Consortium, GRCh38.p4 Release date: June 29, 2015](https://www.genome.gov/36081540)
- Cat genome size: [Nature](https://www.nature.com)
- Dog genome size: [GenomeWiki](https://www.genomewiki.org)
- Elephant genome size: [Animal Genome Size Database](https://bioinformatics.med.unc.edu/animal-genome-size.html), calculated from C-value using average of two entries
- Baker’s yeast genome size: [Scientific American](https://www.scientificamerican.com)
- DVD size: [Optical Storage Technology Association](https://www.opticalstorage.org)
- 1500 sperm per second: [National Geographic](https://www.nationalgeographic.com)
- Average male life expectancy: [CIA World Factbook](https://www.cia.gov)
- Average age of puberty, males: [NHS](https://www.nhs.uk)
- Global Internet traffic per month 2015: [Cisco](https://www.cisco.com)
- 400 eggs per lifetime: [New York Times, Cleveland Clinic](https://www.nytimes.com)
- Girls episode length: [IMDb](https://www.imdb.com)
- Video filesize: [Toolstud.io](https://toolstud.io)
BODY SIZE

POUNDS OF FLESH

Your data used Sex, Mass, Age (latter used for brain only)

How we worked this out
We used equations published in the scientific literature to predict the mass of your individual organs and tissues based on your sex and body mass (for all organs except your brain) and your sex and age (for your brain). These equations give approximate results and were derived from autopsy records of people who lived in the USA, so it’s possible they won’t be equally correct for people from different places.

The equations do not work as well for people whose mass is less than 50kg so some values were adjusted to produce sensible results.

‘Body fat and other organs’ includes body fat, connective tissues and all other body parts, and is calculated as your body mass minus the sum of the mass of your other organs and tissues. It should not be taken as a reliable indicator of your body fat percentage.

For women, ovaries were assumed to have a fixed mass of 5g each, based on a study of their volume.

Sources
Mass of all organs except brain and ovaries: Young et al 2009
Mass of brain: Debakan and Sadowsky 1978
Mass of ovaries: Pavlik et al 2000
‘Mass’ of soul: LiveScience

BODY OF WATER

Your data used Age, Sex, Height, Mass

How we worked this out
We often hear that the human body is 70% water, but in fact the proportion of your body mass that is water varies between about 50% and 75%. Babies have a higher proportion than adults and men tend to have a higher proportion than women. On the whole, the more body fat you have, the lower the proportion of water. This is because fat is only 10% water.

We estimated the amount of water in your body using equations based on data on 458 men and 265 women from 30 different studies. For men, the equation is based on age, height and mass. For women, it is based on height and mass only. All the study subjects were over 17 years old and none were Asian, so results may be less accurate for children or people of an Asian ethnic background.

The equations did not work well for very small or very large people, so we imposed a 50% floor and 75% ceiling on the results.

Sources
Water equations: Watson et al 1980
Water content of blood / skin / bones / fat: Pivarnik and Palmer 1994 via Hydration for Health
**ROOM TO BREATHE**

*Your data used* Age, Sex, Height

**How we worked this out**

Some terminology first:
- After fully breathing in = total lung capacity
- Difference between fully breathing in and fully breathing out = vital capacity
- After fully breathing out = residual volume

The results are calculated from equations that predict vital capacity. These equations are based on data from over 160,000 healthy nonsmokers aged between 3 and 95. Residual volume is assumed to be 24% of vital capacity for males and 28% for females. Total lung capacity is calculated as the sum of functional vital capacity and residual volume.

This is one of the most ballpark results. Our equations are based on Caucasian people, and lung capacity can be different for other ethnic groups. These figures are for healthy people. If you smoke or have lung disease, your lung capacity may be much smaller than this.

The largest recorded lung capacity is 11.7 litres and belongs to British rower Peter Reed, measured in 2009. (Other athletes such as freediver Herbert Nitsch are unofficially reported as having larger capacities.) If you are a young adult and very tall, our equation may predict you have a lung capacity as high as or even higher than this. If so, perhaps you should give rowing a go?

**Sources**

Forced vital capacity equations: [Quanjer et al 2012](#)

Residual volume as proportion of vital capacity: [Wilmore 1969](#)

Largest recorded lung capacity: [British Rowing, Sky, Slate](#)

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**STRETCH OUT**

*Your data used* Height, Mass

**How we worked this out**

We used a formula to calculate your skin surface area based on your height and mass. The length of your small intestines is calculated by multiplying your height by one of three factors, depending on which height band you fall into. Small intestines make up about two thirds of the total length of your intestines, so we divided small intestine length by two to get large intestine length.

The length of DNA in one of your cells is calculated from the length of one base pair (3.4 Angstroms, 1 Angstrom = one ten-billionth of a metre) multiplied by the 3.2 billion base pairs in each human genome, multiplied by two, because there are two sets of chromosomes in most of your cells (these are called diploid cells). The result is a remarkable 2.2m of DNA per tiny cell.

**Sources**

Skin surface area formula: [Haycock et al 1978 via Global RPh](#)

Small intestine length formula: [Gondolesi et al 2012](#)

Length of one base pair: [The Encyclopedia of Earth](#)
Your data used Sex, Mass, Age (latter used for brain only)

How we worked this out
We calculated all organ volumes from organ mass, assuming an average human tissue density of 1.05g/cm³.

Liver, heart, kidney, prostate and testicle volumes are calculated by dividing the calculated mass of these organs in your body (see Pounds of Flesh for method) by an average tissue density of 1.05g/cm³. Eye volume assumes each eye has a mass of 7.5g. Ovarian volume is a rough average (ovaries vary a lot in size).

Lung volume calculated as sum of lung tissue volume (lung mass / 1.05) plus air when fully inflated – see Room to Breathe for lung capacity calculation method.

Brain volume is derived from average values for brain mass for each sex and age group based on US autopsy reports from people who died at various ages from birth to their late eighties.

Ball volumes were calculated from ball diameter. Tennis ball dimensions vary depending on ball type: a diameter of 6.7cm was assumed.

The organ volumes are illustrated as spheres but organs are irregular shapes in reality.

Sources
Liver, heart, kidney, prostate, testicle, lung tissue mass: [Young et al 2009](#)
Lung capacity: [Quanjer et al 2012](#)
Brain mass: [Debakan and Sadowsky 1978](#)
Ovary volume: [Pavlik et al 2000](#)
Basketball volume (regulation size 7 ball): [Top End Sports](#)
Tennis ball volume: [USTA](#)

BODY BUILDER

BODY CLOCKS

Your data used Age, Sex

How we worked this out
All these figures are particularly approximate and will vary considerably between different people.

Heartbeats
We multiplied the average daily resting pulse rate for your sex

- Males: 70-72 beats per minute, 71 taken as average, so 102,240 beats per day
- Females: 78-82 beats per minute, 80 taken as average, or 115,200 beats per day
by the number of days you have been alive.

Heart rates will be much higher during exercise, but lower during sleep. They will also differ between individuals to a large extent and likely be higher for children. So your heart has probably beat even more times than this, particularly if you are a child or if you exercise a lot.
Breaths
Adults take around 15 breaths per minute while resting, but newborn babies take up to 44. We worked out roughly how many breaths per minute you would take during each year of life, using data on resting breathing rate for different age bands and taking the cumulative average for your lifespan so far. Then we multiplied this by the number of years you have been alive. Again, you will have breathed much more if you exercise.

Blinks
The average person blinks 17.5 times per minute or 25,200 times per day. We multiplied this by the number of days you have been alive to get a total figure. We then multiplied this figure by two-thirds, assuming you spend one third of your life asleep and so not able to blink.

Yawns
The average person yawns 10-20 times a day; we took 15 as a rough average and multiplied this by the number of days you have been alive to get a total figure.

Farts
Most people break wind 10-20 times a day, averaging about 13.5 times. Men do not appear to fart more than women, though studies are few and far between.

Sneezes
According to a 2002 study entitled ‘How often do normal persons sneeze and blow the nose?’, 95% of people sneeze and blow their nose less than four times a day. The measured average for sneezes was 1.2. We multiplied this figure by your age in days. You can bump this figure up if you suffer from lots of colds.

Sources
Heartbeats: Livestrong
Breaths: NHS
Blinks: Nakano et al 2012
Farts: Furne and Levitt 1996, Merck Manuals, Discover Magazine
Yawns: Encyclopedia of Sleep and Dreams, Singer et al 2007
Sneezes: Hansen and Mygind 2002

BODILY FUNCTIONS

Your data used Age

How we worked this out

Liquids
- Wee - We used 1.42 litres as the average daily production of urine for an adult and 0.71 litres for a child aged 0-18 years. These figures are taken from a 2015 review of studies reporting healthy individuals (Rose et al, 2015). But they don’t take into account other factors that have an important influence on urine production, such as fluid intake and physical activity.
- Sweat – Estimates of the daily production of sweat under ‘normal’ conditions vary, but tend to fall in within the range of 100ml and 700ml. We use 400ml a day as an average. Note that
these figures do not reflect our capacity to sweat, which can reach several litres during heavy exercise in hot weather.

- **Tears** – We used your date of birth to work out the number of days you’ve been alive and multiplied this by the daily production rate of basal tears. We use 0.925ml as the average daily production of basal tears, based on a 2012 study. Basal tears are the tears that are produced constantly to keep your eyes moist and do not include your reflex tears (produced to protect our eyes from irritation such as dirt and onions) or emotional tears (which are stimulated by brain activity). So if you prepare a lot of onions or watch a lot of weepy movies, assume this figure is an underestimate.

- **Blood** – This is an indication of the amount of blood you have pumped around your body. To work this out, we use your age to estimate your cardiac output per minute and multiply this by the approximate number of minutes you’ve been alive based on your date of birth. For adults we use the 5.5 litres as the average amount of blood pumped per minute and for children as follows:
  - 15-18 years old - 6 litres/minute
  - 10-14 years old - 3.9 litres/minute
  - 8-9 years old - 3.5 litres/minute
  - 5-7 years old - 2.75 litres/minute
  - 4 years old - 2.525 litres/minute
  - 2-3 years old - 1.75 litres/minute
  - 1-2 years old - 1.4 litres/minute
  - 6-12 months old - 1.15 litres/minute
  - 0-6 months old - 0.9 litres/minute

- A 50m x 25m x 2m Olympic swimming pool has a capacity of 2.5 million litres.

**Solids**

- We used your date of birth to work out the number of days you’ve been alive and multiplied this by the daily production rate of faeces. We use 128g as the “average” daily production of faeces for an adult, 80g for an infant aged 1-3 years, 224.5g for a child aged 3-18 years and 114g for an adult over 65. These figures are taken from a 2015 review of studies reporting healthy individuals (Rose et al, 2015). But they don’t take into account other factors that have an important influence on faeces production, such as food intake and diet.

- We measured how many portable event toilets (90in x 44in x 48in) this would fill

**Gases**

We used your date of birth to work out the number of days you’ve been alive and multiplied this by the daily production rate of fart gases. We use 1250ml as the average daily production of fart gases for adults and children alike. This figure is the mean of an estimate that the average person releases between 500 and 2,000ml of gas per day rectally. This estimate was provided by gastroenterologist, Dr Michael Levitt, in Discover Magazine.

We took the dimensions of the volume of the most common and iconic red telephone box, Kiosk 6 (8ft x 3ft x 3ft) to calculate its volume in litres (2,039). We then divided the volume of fart gases you’ve produced in your lifetime by 2,039 to get the number of telephone boxes you could fill with your farts. Imagine that.

**Sources**

Sweat production, lower range: Sherwood 2012
Sweat production, upper range: McArdle et al 2006
Tears production: Kehinde et al, 2012
Blood pumped for adults: Scanlon and Sanders 2014
Blood pumped for children: Oakes’ Respiratory Update
Volume of an Olympic swimming pool: FINA
Urine and faeces production: C. Rose et al 2015
Volume of a portable event toilet: Tardis Environmental UK
Fart gas production: Discover magazine
Volume of a K6 telephone box: The Telephone Box

CUTTING ROOM

Your data used Age

How we worked this out

Hair
So in order to work this out, we just took the average hair growth rate in each part of the body and multiplied it by your lifespan, right? Wrong. Hairs are in cycles of growth and rest. During the rest part of the cycle, they stop growing, so we factored in the likely duration of these growth and rest cycles to the growth rate. Then we multiplied it by your lifespan.

Hair growth rates:
- Eyebrow hair - 0.0533mm per day
- Leg hair - 0.0840mm per day
- Armpit hair - 0.1714mm per day
- Head hair - 0.3265mm per day

The longest hair was on the head of Xie Qiuping of China.

Nails
Nail growth rates are taken from a study of 153 men and women in India and are the average of left and right hands and feet. In reality, nails grow somewhat slower in winter than summer and in older than younger people.

Nail growth rates:
- Big toe nail - 0.048mm per day
- Thumb nail - 0.086mm per day
- Middle finger nail - 0.0905mm per day
- Little finger nail - 0.0765mm per day

The longest nail was formerly on the thumb of Lee Redmond of the USA, but she broke it in a car crash in 2009, along with her other nails.

These results are very approximate: hair and nail growth varies considerably from person to person.

Sources
Hair growth rates and growth/rest durations: Transgender Care

Hair growth rate, second sources:
Armpit, leg: Robertson (ed.): Forensic Examination of Hair
Head: WebMD
**DIE ANOTHER DAY**

**Your data used** Age

**How we worked this out**
We used data on cell turnover time for different cell types, taking the average of two or three sources. Cells are constantly being replaced, and cell turnover time is the lifetime of each cell. Not all cells are replaced: cells in the lens of your eye cannot repair themselves when damaged. Most brain and nerve cells last a lifetime, although cells in the hippocampus brain region can regenerate. The hippocampus is involved in learning and memory. We generate around 1400 new neurons each day.

The outer layer of skin is known as the epidermis. Liver cells refers to hepatocytes, which make up 70-85% of the liver by mass.

**Sources**
Cell turnover time, all cells: Cell Biology by the Numbers (Bionumbers), New York Times
Cell turnover time, outer skin cells: Iizuka 1994

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**INTERNAL COMBUSTION**

**Your data used** Age, Sex, Height, Mass

**How we worked this out**
We estimate how many calories you would burn if you were to do nothing but rest for 24 hours. In other words, the minimum amount of energy required to keep your body functioning.

This is known as your resting metabolic rate and is calculated using the Mifflin St Jeor equation:
- for men: $10 \times \text{mass (in kg)} + 6.25 \times \text{height (in cm)} - 5 \times \text{age (in years)} + 5$
- for women: $10 \times \text{mass (in kg)} + 6.25 \times \text{height (in cm)} - 5 \times \text{age (in years)} - 161$

We also worked this out for famous athletes
- for men: Usain Bolt and Mo Farah
- for women: Jessica Ennis and Serena Williams

These values will probably be underestimates as athletes have a high percentage of body mass as muscle and a low body fat percentage. Since muscle burns more calories at rest than fat, athletes are likely to have a faster metabolic rate than this equation would predict.

We then contextualise this by showing what this equates to in terms of:
- number of pizzas eaten (based on one serving of a Pizza Express Margherita Classic Pizza containing 682kcal)
- number of hours running (using Metabolic Equivalent Task (MET) scores, which refer to the number of times resting energy expenditure the activity burns. So a MET score of 2 burns twice as many calories per time period as at rest, a score of 5 burns 5 times as many, and so on.)
Sources
Resting metabolic rate: Mifflin St Jeor equation
Age, height and mass of famous athletes: Sports Reference
Calories in a pizza: NHS Calorie Counter
MET score for running: Top End Sports