

Situation:

The human body – a numeric masterpiece

Our brain performs 10 quadrillion actions per second.

We need 40 muscles to frown.

Blood rushes through the entire circulatory system in less than a minute.

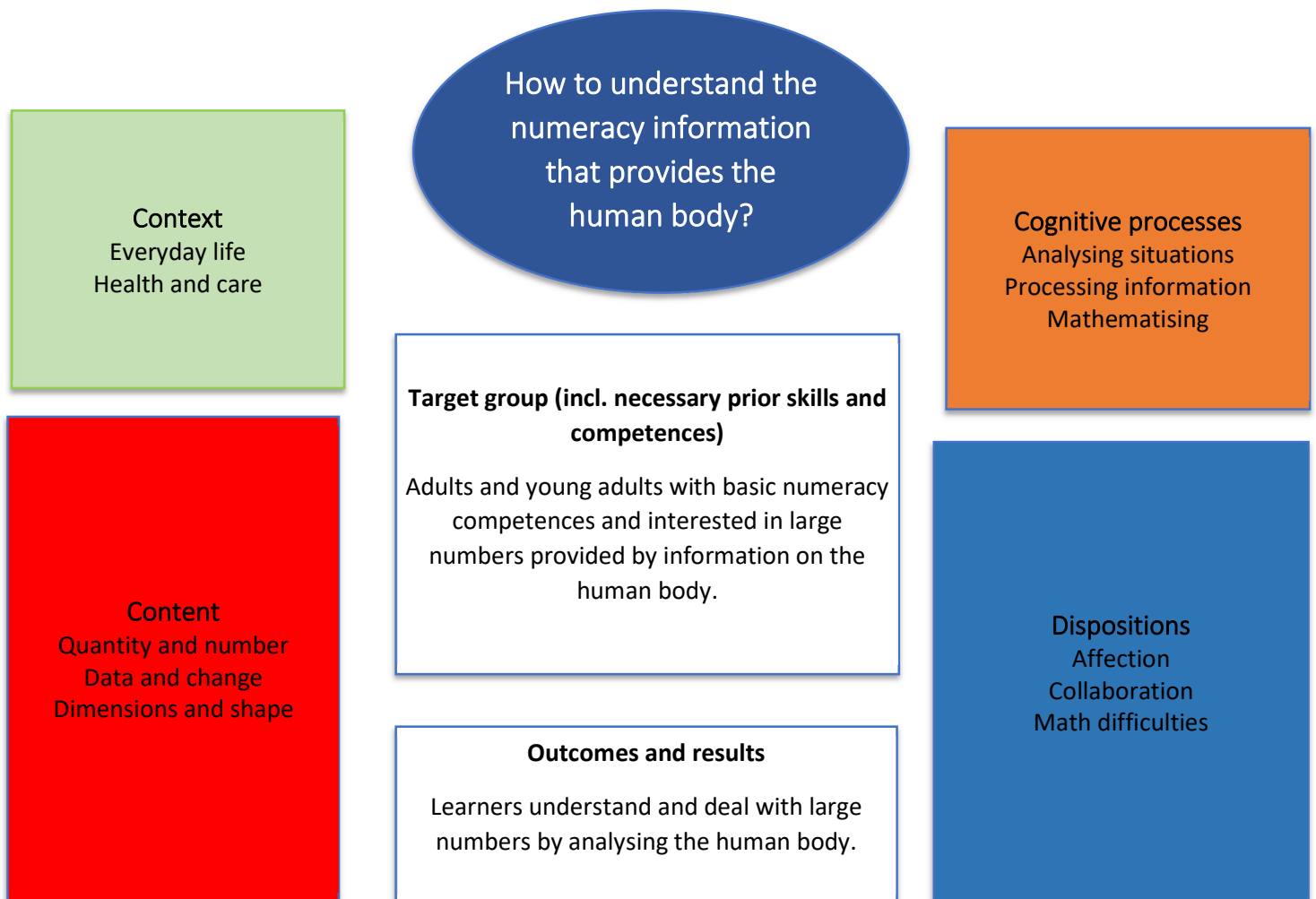
Our eyes focus 100,000 times a day.

8 per cent of all people have one more rib.

The human body is a masterpiece of flesh and blood... and numbers.

Curious and interesting facts about our bodies allow us to immerse ourselves in the world of (large) numbers and look at our own bodies with mathematical eyes.

Overview “The human body – a numeric masterpiece”



Main information	
Content	Natural numbers (large numbers) Decimal numbers Diagrams and graphs Floating point representation
Target group	Adults and young adults with basic numeracy competences and interested in large numbers provided by information on the human body.
Learning intention	<ul style="list-style-type: none"> – Numeracy for personal and private purposes – (Numeracy for higher education or studies)
Duration	Approx. 4 lessons
Material and resources	Infographic (see appendix 1) Worksheet with calculation occasions based on facts and figures on the human body (see appendix 2) Internet, computer, beamer
Group size	Range from 6 to 15 learners
Problem statement	We are confronted with large numbers in multiple situations in our everyday life. Yet, those large numbers are often perceived by learners as very abstract and can cause math anxiety.
Working questions	<ul style="list-style-type: none"> ▪ How do we organize numbers? ▪ What do the concepts of million, billion, trillion mean? ▪ How to note these concepts with numbers? ▪ How can we make large numbers more “tangible”? ▪ What do these facts really mean for our body?
Learning outcomes and results	The students analyze and organize large numbers. The students are familiar with the concepts of million, billion and trillion. The students apply possibilities to note large numbers in a mathematical way. The students work out the presented facts within calculation occasions on the human body.
Reference to National Qualification Frame	Optional (country’s decision)

Working plan

Time (lessons)	Description of content/activities	Material	Methodical and didactic information ¹
25 min	<p>Activation:</p> <p>The learners are shown an infographic with astonishing facts and figures on the human body, for example: "Once to the moon and back: our body in numbers. Once to the moon and back: that's the total length of the nerve tracts in the human body."</p> <p>The presented facts and figures are discovered and discussed within the whole group or in small group work.</p>	<p>Infographic with facts and figures on the human body, for examples see appendix 1</p>	<p>Activation Mathematising</p> <p>Alternatively, the learners can be asked to search for those facts and figures by themselves in advance of this phase.</p>
55 min	<p>Activity 1: Endless numbers?</p> <p>(Large) numbers are taken from the graph and initially sorted by size.</p> <p>Activation the learners' prior knowledge, the teacher notes and discovers the orders of magnitude (hundred – thousand – million – billion – trillion – quadrillion) together with the learners. It is important here that the students link the linguistic terms with the mathematical quantities (number of zeros).</p> <p>Now the learner group concentrates particularly on large numbers and considers how these numbers can be put together or explained. Based on the learners' hypotheses, powers of ten and floating-point notation are introduced.</p> <p>Examples for facts with large numbers:</p>	<p>Numbers from the infographic used for activation (appendix 1).</p>	<p>Questioning Collaborative learning Hands on learning</p> <p>If the level of knowledge within the group differs greatly, it can be useful to start working in subgroups within this phase already, letting one subgroup discover large number notation while other groups of learners concentrate on</p>

¹ for description and explanation of kinds of tasks, HITs and other background information please consult the teachers' guide



	<ul style="list-style-type: none"> ▪ The body produces 1,000,000 new cells every hour. ▪ 250 million platelets are contained in one liter of blood. ▪ The total length of the nerve tracts extends from the earth to the moon and back = 768,800 kilometers! ▪ There are 100 billion nerve cells in our body, about 14,000,000,000 of them in the brain alone; 50,000 to 100,000 nerve cells die every day. ▪ A person blinks about 20 times a minute (415 billion times in a lifetime). ▪ 100 trillion bacteria live in our intestines. 		numbers up to 1000, e.g.
100 min	<p>Activity 2 and transfer: Getting to the heart of the numbers</p> <p>Some of the facts on the human body are now embedded in calculation occasions that help the learners to get to the heart of the numbers and to understand the concrete meaning of these facts for their own body.</p>	Calculation occasions based on the facts and figures discovered and discussed before – see appendix 2 for examples	

Suggestions for the teacher

The example presented here should be considered as exemplary and inspirational material presenting a guideline with a high range of possibilities of adapting those suggestions to a specific group of learners or an individual learner with his or her very personal requirements.

In concrete terms, the example "The human body – a numeric masterpiece" could be adapted the ways:

- **Autonomy:** The learners can be put in more autonomous learning situations, for example by adapting the phase of activation. Here, the learners can be asked to search on the internet for interesting facts and figures about the human body in small group work. Thus, the infographic would not be prepared by the teacher but by the learners themselves. Furthermore, it can help to engage and involve the learners in their own learning process if they work with facts and numbers that they have researched themselves and that interest or astonish them personally.
- **Level of difficulty and individualization:** The degree of difficulty of this example depends very much on the facts and figures selected and processed. So, the level of difficulty can also be differentiated within subgroups working on individualized tasks (one group working with natural numbers in the number range up to 1000, for example, while another group works with floating point or decimal numbers).

Our educational activities aim at numeracy skills being not only memorized, but first of all being practiced and functionally used by the learners in daily life or/and vocational situations. It is therefore recommended to implement the idea of HITS² (higher impacts of teaching skills) as far and often as possible: ...

- ... work with concrete and authentic material that learners will recognize from everyday life situations. For this example, prior knowledge of the learners from the field of biology, but also everyday knowledge on the human body, can be activated.
- ... ask the learners questions and let them raise questions themselves. It can be crucial to discuss numeracy themes, contexts and numbers.
- ... think of possible ways of transfer: When working with large numbers and floating point notation, learners can be asked, for example, to find other situations in everyday life in which such numbers occur.

² For general information and explanation on HITS please see the teachers' guide

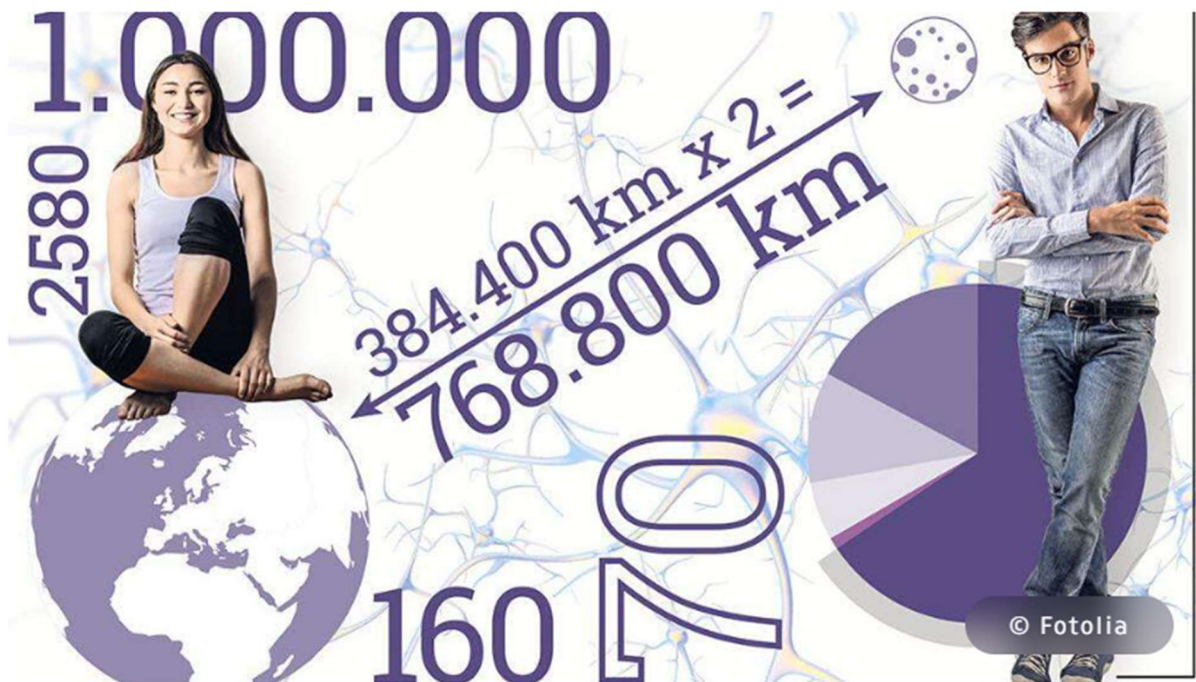


Appendix

Appendix 1: Infographic for activation

You can find these and countless other interesting facts and figures about the human phenomenon here:

https://www.kleinezeitung.at/service/infografiken/grafikdestages/5325511/Grafik-des-Tages_Unser-Koerper-in-Zahlen [28.12.2023]



Source: www.kleinezeitung.at [28.12.2023]

 **Gehirn**

1350 bis 1500 Gramm wiegt das menschliche Gehirn.

0,5–120 Meter pro Sekunde beträgt die Geschwindigkeit, mit der die Nervenzellen Impulse weiterleiten.

$384.400 \text{ km} \times 2 = 768.800 \text{ km}$

 Die **Gesamtlänge** der Nervenbahnen reicht von der Erde bis zum Mond und zurück.

100 Milliarden Nervenzellen gibt es in unserem Körper, etwa **14 Milliarden** davon allein im Gehirn. **50.000 bis 100.000** Nervenzellen sterben täglich ab.

 **Sinne und Sinnlichkeit**

60 Bilder pro Sekunde nimmt das Auge wahr.

3 Milligramm wiegt der kleinste Knochen unseres Körpers – der Steigbügel im Ohr.

1000 Gerüche kann der Mensch unterscheiden.

Ein Mensch blinzelt etwa **20 Mal pro Minute** (**415 Millionen** Mal im Leben). Er kann **0,67 km** weit sehen. **95%** der Sinneswahrnehmungen sind optisch.

5 **Geschmacksrichtungen** können wir unterscheiden: süß, sauer, salzig, bitter und umami (herzhaft). Teenager besitzen rund **9000 Geschmacksknospen**, alte Menschen nur etwa **4000**.


 **Sex**

2580 Mal haben wir im Durchschnitt im Leben Sex, mit **5 Partnern**. Verliebt sind wir zwei Mal und küssen zwei Wochen lang.

12 bis 24 Stunden Zeit bleiben zur Befruchtung des Eies nach dem Eisprung.

50 Millionen Samenzellen produziert jeder Hoden pro Tag.

44,8 km/h schnell ist das Ejakulat des Mannes beim Samenerguss.

 **Haare/Haut/Nägel**

40 bis 120 Haare verliert der Mensch pro Tag.

80.000 bis 150.000 Haare haben wir auf dem Kopf. Ein Haar ist **0,007 bis 0,18 Millimeter** dick.

0,2 bis 0,3 Millimeter wächst das Haar pro Tag. Im ganzen Leben sind das etwa **50 Meter**.

Männer und der Haarausfall: Nur **20 Prozent** aller Männer bleiben ihre Kopfhaare das ganze Leben lang erhalten, bei genauso vielen beginnt die Glatzenbildung schon mit **25 Jahren**.

Source: www.kleinezeitung.at [28.12.2023]



10 AMAZING FACTS ABOUT THE HUMAN BODY

01 Infants Infants are born with approximately 300 bones, but as they grow some of these bones fuse together. By the time they reach adulthood, they only have 206 bones.

02 Location More than half of your bones are located in the hands, wrists, feet, and ankles.

03 Cells Every second, your body produces 25 million new cells. That means in 15 seconds, you will have produced more cells than there are people in the United States.

04 Bone Sizes The largest bone in the human body is the femur, also known as the thigh bone. The smallest bone is the stirrup bone, which is located inside your ear drum.

05 Blood Vessels There is anywhere between 60,000-100,000 miles of blood vessels in the human body. If they were taken out and laid end-to-end, they would be long enough to travel around the world more than three times.

06 Teeth Teeth are considered part of the skeletal system, but are **not counted as bones**.

07 Brain Despite accounting for 2% of our body mass, the brain uses 20% of our oxygen and blood supply.

08 Running While humans are not the biggest, fastest, or strongest animals around, we are the best at something: **long distance running**.

09 Water About 60% of your body is made up of water.

10 Strong Bones Pound for pound, your bones are stronger than steel. A block of bone the size of a matchbox can support up to 18,000 pounds of weight.

Source: <https://www.osgpc.com/amazing-facts-about-the-human-body/> [28.12.2023]

27 A person's feet has about 500,000 sweat glands and can produce about a pint of sweat a day.^[1]

28 A human sneeze can travel about 100 mph or more.^[1]

29 The average human produces 25,000 quarts of saliva in a lifetime, enough to fill two swimming pools.^[23]

Source: <https://www.factretriever.com/body-facts> [28.12.2023]



Appendix 2:

Worksheet with calculation occasions based on facts and figures on the human body

Sources of pictures: www.pixabay.com [28.12.2023]

The human body – a numeric masterpiece

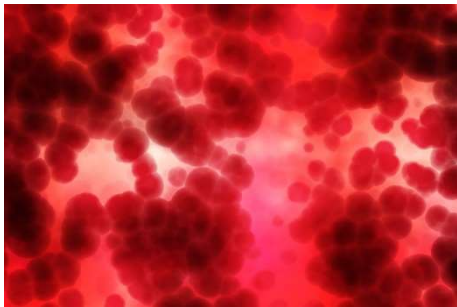
Find out 1: Measuring our pulse



Try to measure your pulse. How often do you count it in one minute? Means, how often does your heart beat in one minute?

How often does it beat in an hour? How often in a day? How often in an average human life?

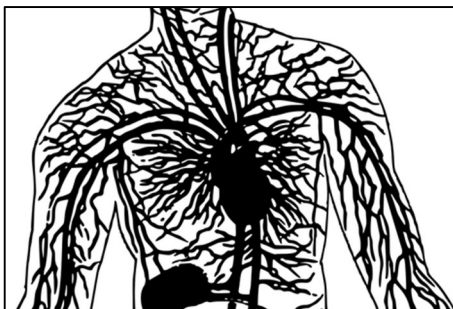
Find out 2: Blood circulation



Around 5 liters of blood flow through our body. All of our blood rushes through our entire circulatory system in less than a minute.

Think about: How many liters flow through the body in 1 hour, in a day, in a year, in an average human lifetime?

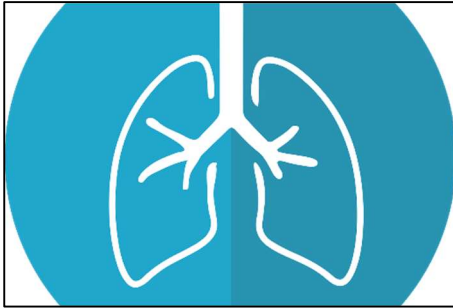
Find out 3: Our vascular system



Our entire vascular system with veins and arteries measures more than 100,000 kilometers in length, including all the small branches.

Hypothesize, then try to calculate: How many times could you circumnavigate the earth? (Earth diameter = 12 742 km)

Find out 4: Breathe in – breathe out

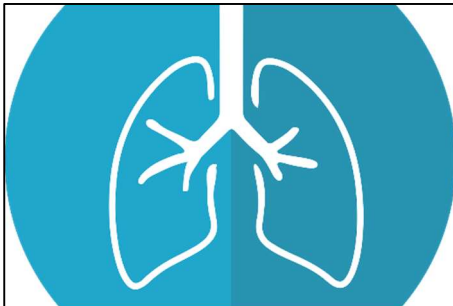


Observe your breathing: How often do you breathe per minute?

How often do you breathe in an hour? How often in a day?

Half a liter of air flows into our lungs 12 to 17 times a minute. How many liters of air do we use in a day?

Find out 5: Our lungs



The surface area of an adult's lungs is approximately 78 square meters.

Hypothesize, then try to calculate: A table tennis table is 4.16 m² in size. How many table tennis tables make up the surface area of the lungs?

Find out 6: Filling pools with saliva?



1.5 litres of saliva are produced by our salivary glands every day.

How much saliva is produced in the course of a human life?

Hypothesize, then try to calculate: Could you fill a swimming pool with it?

Find out 7: Endless hair?



A human hair grows on average 0.35 mm per day.

How long does it take for your hair to grow 10 cm?

How many cm would the hair grow in a human lifetime if it was not cut or didn't break?