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How large would a USB flash drive be if one byte of data required the volume of one human bite?

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Abstract
Data storage approximately follows Moore's Law, meaning that data is being stored in much smaller volumes. In this paper, the volume required to store the data on current common USB flash drives if one byte of data was the size of human bite is calculated. It is determined that the volume required to store 128 GB of data is just over a trillion centimetres cubed. For a 16 GB flash drive, it is determined that the bite size storage device would be 54.7 billion times larger than common current technology.

Introduction
The byte is a unit of digital information, usually representing eight bits [1]. The origin of this word is from 'bite', however, it was deliberately misspelled to avoid confusion with 'bit' [2].

The size of the equipment used to store data has decreased at a rate roughly proportional to Moore's Law in recent history; this is because the electronical components needed are similar to that of processors. In the first half of the twentieth century the size of equipment to store one byte far exceeded the size of a human bite [3]. Now however, terabytes of data can be stored on increasingly small hard drives as well as solid state drives [4].

The size of a human bite
It is hard to measure the size of a human bite as not only do they vary with genetics but also by environmental factors. A single human will also vary their bite size dependent on the food stuff that is being eaten, as well as a large number of other factors [5]. One study into 50 young Japanese females showed that when eating apples and rice, the median volume of food consumed in one bite was around 8 cm^3 [5]. The maximum volume of 21.4 cm^3 demonstrates the variability between individuals [5].

Calculations
USB flash drives can be found in a variety of sizes now, in 2016. The largest size currently possible is 1 terabyte, however, this is extremely expensive [6]. Common sizes are 8 GB, 16 GB, 32 GB, 64 GB, and 128 GB and these sizes are becoming increasingly more compact. The "Kingston Technology GB Data 16 Traveler" measures in at 3.9 × 1.2 × 0.5 cm [7] which is equivalent to a volume of 2.34 cm^3.

This 16 GB USB flash drive can store 16,000,000,000 bytes as one Gigabyte is equivalent to 1,000,000,000 bytes. If the volume required to store each one of these bytes was 8 cm^3, then the volume of the flash drive could be calculated to be:

$$16 \times 10^9 \times 8\ cm^3 = 128 \times 10^9 cm^3$$

This is equal to a volume of 128,000 m^3. This volume is equivalent to just over a cube with sides of 50 m. It is possible to calculate how much larger this is than a flash drive by:

$$128 \times 10^9 \div 2.34 = 547 \times 10^8\ (3\ s.f.)$$

This means that a memory stick would be 54.7 billion times larger if the volume of space needed to store one byte was equal to one human bite.

By using the same method as before, it can be calculated that the volume for a 128 GB flash drive is 1.024 trillion cm^3. This is equivalent to a cube with

sides of just over 100 m. To visualise this, knowing that the City of London is 2.9 km^2 [8] (equal to 2.9×10^5 m^2), this storage device would be 35.3 cm^3 thick on the top of this area.

Conclusion

To conclude, if the volume of space needed to store one byte of data was actually the volume of one human bite, then memory storage devices would be extremely large and impractical. It has been calculated that for a 128 GB USB flash drive, just over a trillion cm^3 would be required to store the data, equivalent to an area of space 35.3 cm over the City of London. For a 16 GB memory stick the area required is 54.7 billion times larger than a common current USB flash drive.

These calculations show how far data storage has come since the beginning of computing, when storing one byte of data in the volume of one human bite would have been seen as a great achievement.

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