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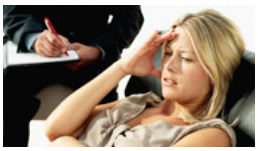

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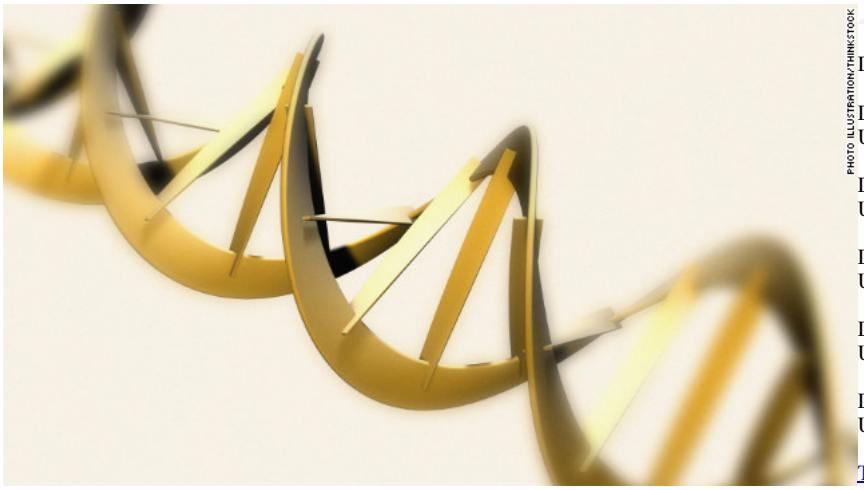

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Shakespeare, thou art stored in DNA

The stuff we're made of may be the means by which we store information that we want kept around long after we're gone.

Scientists have developed a technique of storing information in DNA, the molecule found in living

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creatures including humans that contains genetic instructions. The experiment is discussed in a new study in the journal Nature.

Researchers aren't using DNA from any living organism, or one that was once alive; instead, they are synthesizing it.

"We're using DNA here as a chemical molecule of storage. It just happens to be the same molecule that is used in our bodies as well," said Ewan Birney, senior author of the study and geneticist at the United Kingdom's European Bioinformatics Institute, at a press briefing Tuesday.

As long as the DNA is kept cold, dry and dark, it will last for a long time. Consider that scientists can sequence DNA from woolly mammoths tens of thousands of years old that's preserved by chance.

"There must be some point in time when it's cheaper to store information for that length of time as DNA than as something that requires electricity or some other maintenance cost to keep it around," Birney said.

Birney and colleagues did the math, and found that although DNA storage is expensive, it's more cost-effective than other methods if you want to preserve a digital file for somewhere between 600 and 5,000 years. However, the scientists say the synthesis cost will probably come down in the next decade, so DNA storage could even work for ensuring your grandchildren can see your wedding photos.

"Anything that you want to store we could store," Birney said. "Really, the only limit is the expense."

Study collaborators at Agilent Technologies provided DNA synthesis free of charge for the Nature paper, but commercial rates for DNA synthesis are probably between $10,000 and $30,000, researchers said.

The technique, researchers said, could even encode a zettabyte's worth of data. That's enough to encompass the total amount of digital information that currently exists on Earth, which would be "breathtakingly expensive" right now, Birney said.

Researchers used five different kinds of digital information to show that their method would work to preserve a variety of media in DNA. These included a text file with William Shakespeare's 154 sonnets, a PDF of a scientific paper, a photo in JPEG format of the European Bioinformatics Institute, and an MP3 audio excerpt of Martin Luther King's "I Have a Dream" speech.

Scientists showed that they could encode these files in DNA and then, by sequencing the DNA, reconstruct them with 100% accuracy.

So how would your digital files translate into DNA?

Text on your computer, while it may look like words, is actually encoded in your computer as ones and zeros - this is called binary. For the purposes of DNA synthesis, scientists took that information and converted it to base 3 – that is, zeroes, ones and twos.

From there, the data gets translated into collections of DNA's nucleic acid bases, represented by the letters A, C, G and T.

That's how scientists encode the DNA fragments.

This is not the first study of its kind. In 2012, George Church of Harvard University and colleagues published a paper in the journal Science describing their own strategy for DNA storage. That research group operated independently from the British scientists.

One distinguishing factor in the new study is error correction, Goldman said. Built into their method are measures that adjust for possible errors in translating the digital material into DNA and back again.

An example is that the translation method in Goldman's study does not allow for identical letters of DNA to be next to each other - in other words, there are no instances of "AA" in the final DNA code, since this kind of repetition could cause errors, Birney said. They also encode the same piece of information multiple times in different ways in the DNA, in case something goes wrong.

DNA has the advantage of being light and small, researchers said. One of Shakespeare's sonnets would weigh 0.3 picograms (10^-12) grams, said Nick Goldman, lead study author.

A small test tube holds about a petabyte – a billion megabytes – of data. DNA storing this much information is about as big as the space between the top two joints of your little finger, Goldman said.

"A gram of DNA would hold the same information as a bit over a million compact discs," Goldman said. "Your storage options are: one thing a bit smaller than your little finger, or a million CDs."

Given DNA's small size and long endurance, according to Goldman and Birney, the method could be used to propagate information about our current selves thousands of years into the future - assuming, of course, our descendants in the year 4013 understand languages as we speak and write them today.

Post by: Elizabeth Landau - CNN.com Health Writer/Producer
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