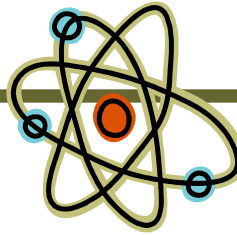
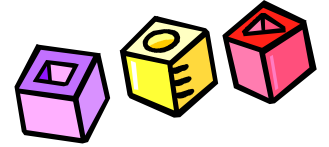


# science FRONTIERS



## Tinier Than Tiniest (String Theory)



If you have ever assembled a model or taken something apart, you know that everything is made of smaller pieces. If you have played with Legos® you know that you can build almost anything with just a few sizes and shapes. In English, you can spell hundreds of thousands of words using only 26 letters. You can use Morse code to spell all the words in the dictionary with only a dot and a dash. One of the fundamental questions of physics is “what are the smallest particles that are assembled in different combinations to make all the matter we know about?”

You and all the stuff around you is made of atoms. Atoms are made of 3 smaller particles: protons, neutrons, and electrons. The difference between lead and gold is caused by the different number of protons in the atom. It is possible to convert lead to gold, but it isn't a good economic decision. The difference between carbon, the most common element in your body, and gold is a difference in the number of protons in the nucleus. We know that protons and neutrons are made of smaller particles called quarks. And quarks are made of smaller particles. So what might the ultimate particles be? Would you believe strings?

String theory is the current name for the study of the fundamental particles in the universe. Strings are believed to be small,  $10^{-33}$  centimeters, or about a millionth of a billionth of a billionth of a billionth of a centimeter. There are different ways of trying to understand strings, but it is possible to imagine a universe with 10-20 individual strings. They could correspond to the various kinds of properties required to explain the universe. Another interpretation is that there are one or two strings and then the way they are bent, twisted, stretched, rotated, vibrated, *etc.* determines their properties. Many theoretical physicists consider strings the leading candidate for the ultimate particle.

Because strings are believed to be so small, they may never be seen. The understanding we have today is purely mathematical. But, if the theory is accurate, strings may explain all matter. If future models reveal a different pattern, scientists may have to find a different particle.

### Questions to Think about or Research:

How might string theory explain the way God organized the universe?  
What do researchers have to know in order to contribute to string theory?

### Research Ideas

Elementary particle, quantum physics