Jumping DNA: "Selfish" jumping genes most common in nature

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(PhysOrg.com) -- It started out with a simple question among a group of scientists from the University of South Florida, San Diego State University and the University of Chicago: Now that scientists have successfully decoded a number of genomes, what gene turns out to be the most common and abundant?

What began as a passing curiosity from the team of scientists, which included USF College of Marine Science researcher Mya Breitbart, has now turned up new insight into the genes that comprise all life. Transposases - so called “selfish DNA” - are the most common and abundant genes on Earth! The abundance and widespread nature of these genes suggests that they play a critical role in evolution and the maintenance of biological diversity.

Because of their unique behavior, transposases have earned several monikers in the scientific community. Some have nicknamed them “selfish” genes because their only known function is to spread themselves around, the scientists said. Transposases are also known as “jumping DNA” due to their ability to move within and between organisms, producing ever-changing genetic materials.

“We also call them ‘cut and paste’ genes,” Breitbart said. “They keep changing and moving, and can also sometimes bring other genes along with them”

The findings are drawing interest not just because they represent a novel

look at a common piece of DNA, but because of the massive computational task involved in the project. The project, which was recently published in the journal *Nucleic Acid Research*, was led by San Diego State University and used one of the world's fastest computers at Argonne National Laboratory in Illinois for the herculean effort.

The group analyzed 10 million protein-encoding genes and gene tags in thousands of sequenced bacterial, archaeal, eukaryotic and viral genomes, as well as hundreds of environmental community metagenomes.

The clear winner was the transposase, a gene which scientists often use in research projects to perform a variety of experiments to mutate, disrupt or knockout genes in the organisms they are studying. But transposases also can bring new functions and create diversity in an organism, Breitbart said.

"We have presented these data at several different meetings, and when we ask scientists to guess the top 3 genes, they rarely make the right guess," said Robert Edwards, an assistant professor of computer science and biology at SDSU and the team leader. "Transposase genes are so ubiquitous in genomes that they are not noticed. They are able to move from spot to spot, causing mutations and rearrangements that are often detrimental, but that occasionally help an organism survive."

Textbooks have taught scientists that the enzyme that fixes carbon dioxide during photosynthesis is the most abundant enzyme on earth, and it is often assumed that the gene encoding this enzyme would also be the most abundant. Ramy K. Aziz, the lead author of the paper and a researcher at Cairo University currently training at San Diego State, said the scientists were expecting this, or other essential genes to be at the top of their list, but were surprised that transposases - considered by some scientists to be "junk" DNA - dominated the known genetic universe.

The genes, though, do retain some mystery. They aren't evenly distributed throughout the natural world, some genomes have many of them while they are absent in other genomes, Breitbart said. "We are really just starting to understand the presence and role of transposases in the environment. These extremely successful genes are spreading their DNA around; making many copies of themselves and invading all types of life."

"Before this study, it was known that transposable elements make up to 40 percent of the human genome; however, there has not been a comprehensive assessment of such genes in different ecosystems," Aziz said. "Now we know that almost every ecosystem sampled to date has a substantial number of these genes, which are known to accelerate mutation and diversification processes, thus driving evolution of different organisms."

Provided by University of South Florida

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