2007 TAIWAN INTERNATIONAL SCIENCE FAIR

CATEGORY : Mathematics

PROJECT : A New 3-Dimensional Model for the Periodic Table of Codons

AWARDS : Mathematics First Award

SCHOOL : Hwa Chong Institution

FINALISTS : Pang Ka Hong,Raphael

COUNTRY : Singapore

Abstract of Exhibit
Taiwan International Science Fair

CATEGORY: Mathematics
TITLE: A New 3-Dimensional Model for the Periodic Table of Codons
NAME: Pang Ka Hong, Raphael
COUNTRY: Singapore

Contents of Abstract: (maximum 500 words) include

a. Purpose of research

Since the discovery of genetic codes and the dogma of 64 codons coding for 21 amino acids, scientists worldwide have been interested to know the reason(s) behind this unique number ratio (64:21).

This ratio indicates certain form of inefficiency in the replication of amino acids. Such inefficiency can be explained through symmetries in the condons coding for the same amino acids.

In the light of that, my project looks for patterns in the properties of amino acids and symmetries in the codons combinations. Using these analysis findings, I invented a three dimensional periodic table for the codons and amino acids that has a points to layers ratio of 64:21.

b. Procedures

To get started with the project, I searched for relevant information in books and the Internet. After locating the relevant materials, I began my analysis by looking for non-random patterns in the correlation between codons and the respective amino acids they code for.

At the same time, I try to look for symmetries in the codon distributions and suggest new and innovative models for a periodic table of codon combinations. I have come out with mainly a new model, with its own unique ideas and concepts behind it.

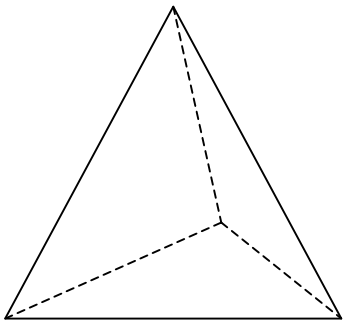
Finally, I will try to match a property of the amino acids to the positions of the codons such that the table shows a gradual change in property of the amino acids, together with the symmetries. This will effectively explain the unique codons to amino acids ratio and lead to discovery of possible amino acids.

c. Data

This research is primarily conducted based on the conventional 2D periodic table and no experimental data is collected.

After much analysis, I have come up with the 3-sided triangular pyramid model. This model is inspired by the ratio of 64 codons coding for 21 amino acids, which can be easily approximated to 3:1.

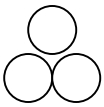
It is made up of a triangular pyramid that is three-faced, with the bottom side unutilized.



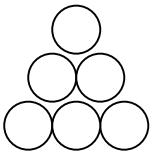
As a triangular structure, each layer has dimensions in the multiples of 3. Layer 1 consists of 1 point, layer 2 with 3 points, layer 3 with 6 points and so on… until layer 7 with 18 points, having a total of 64 points.

Layer 1:

Layer 2:



Layer 3:



Total no. of points in 7 layers = 1+3+6+9+12+15+18 = 64

Since there are 7 layers in each side of the structure, it gives a total of 21 layers in all 3 sides of the structure.

This 64 points to 21 layers ratio is consistent with the codons to amino acids ratio!

d. Conclusions

The unique 64:21 ratio suggest certain form of inefficiency in the replication of amino acids. This may be explained through symmetries in condons coding for the same amino acids. A general 3:1 ratio can be approximated and this suggests a high possibility for the existence of a three-sided symmetry in codon combinations. Thus, this idea of a three-sided symmetry gives rise to my 3-sided triangular pyramid model. This new model of a 3-dimensional periodic table for codon combinations would be useful in explaining such a unique 64:21 ratio and serves to provide a basis for better understanding of the relationship between codons and amino acids. This new model may also lead to the discovery of currently unknown amino acids.

評語

1. The scientific knowledge is clear and extensive. The symmetric structure is elegant and concise.
2. The author has show plans for quantitative analysis of the proposed modeling.
3. The inclusion of I-Ching in two of the references shows the influence of oriental philosophy in the scientific investigation.