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Research Seminar
Research Plan
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Research Project Plan

- **Research Question**
    1. Do all the polyhedra conform Euler's polyhedral formula (F+V-E=2)?
    2. When the different polyhedra (Platonic Solids and Archimedean Solids) are used as dice, will the fairness of the dice alternated corresponding to the increment of the complexity of the polyhedral structures?
- **Hypothesis/Problem/Engineering Goals**
    1. The hypothesis of this science research project is as the complexity of the shape of the polyhedra increases, the polyhedral dice will lose its fairness.

    The goal is to follow the pattern-conjecture-proof process of the mathematic experiment to discover the factors determined the fairness of the polyhedral dice.
- **Description in details of method or procedures**

    Procedures:

    1. First, before the rolling processes start, the construction of different polyhedral dices should be designed already.

    2. There are 18 polyhedra being used in the project, among all, five are Platonic Solids, 13 are Archimedean solids. The layouts of the polyhedra are downloaded from the website and some related books.

    3. After finishing all the construction of the polyhedral dices, the rolling steps and collecting data starts.

    4. The patterns from the experimentation would be discovered and the conjecture would be made from the data.

    5. Each dice should be rolled at least 500 times to have a solid pattern, therefore the rolling work would keep going till the science project ends.

    6. Between the data collecting period, reading more related articles and books to figure some mathematical proof about my project.

7. Also the second part of the experiment is to discover the symmetrical structure of each polyhedral dice. I will randomly rotate the dice in the hands and put down on a surface after rotation to predict the outcome of the number on the face.

Data Analysis

Data would be collected in the example form below. There will have more than 18 tables of data collected in the end of February.

Tetrahedron (200 times)	**Four faces, four vertices, six edges**
Face Number	**Frequency**

Bibliography:

Primary Sources

A different shape for dice. In Vecchione, G. (2005). Blue ribbon-science fair projects. (1st ed.). (pp.184-187). New York: Sterling Publishing Co., Inc., 2005.

1. This primary source is where the idea of my science research seminar based upon. It gives me some ideas for my science research project; then, my curiosity leads me toward another stage of the experiment I would do later.

Paper models of polyhedron. Korthals Altes. April 18th, 2006. Korthals Altes. Retrieved August 4, 2006 from http://www.korthalsaltes.com/.

2. This website is where I received all the layouts or designs for the 17 polyhedrons I am going to construct as a part of my science project. This website contains enough data to allow me use the layouts there to construct. It is very useful for my project.

Weisstein, E, W. Archimedean solid. From *MathWorld*--A Wolfram Web Resource. Retrieved August 18, 2006 from http://mathworld.wolfram.com/ ArchimedeanSolid.html

Weisstein, E,W. Polyhedron. From *MathWorld*--A Wolfram Web Resource. Retrieved August 14, 2006 from http://mathworld.wolfram.com/Polyhedron.html

Weisstein, E, W. Polyhedral formula. From *MathWorld*--A Wolfram Web Resource. Retrieved August 12, 2006 from http://mathworld.wolfram.com/ PolyhedralFormula.html

3. The Wolfram Mathworld provides me concepts about the Platonic solids and Archimedean solids. It is a website source related to the mathematical concepts in every category. Therefore, it is powerful to help me understand the mathematical knowledge I need to use for my science project.

Rigau, J., Fexas, M., & Sbert, M. (2005). Shape complexity based on mutual information. Universitat de Girona, Girona, Spain. Retrieved September 6, 2006 from IEEE Computer Society [PDF] http://csdl2.computer.org/ persagen/DLAbsToc.jsp?resourcePath=/dl/proceedings/&toc=comp/proceedings/smi/2005/2379/00/2379toc.xml&DOI=10.1109/SMI.2005.42

4. This PDF format article provided me some information about the complexity of the shape of polyhedron, which I found it to be useful. Because I need to test the polyhedron's fairness I constructed, the complexity will be a effect influences the fairness of the polyhedron. Therefore, reading and writing down some information helps to understand the complexity change of different solids.

Pegg, E.T. (1994). A complete list of fair dice. University of Colorado at Colorado Springs. Retrieved September 14, 2006. http://scholar.google.com/scholar? hl=en&lr =&q= polyhedron+as+dice

5. This article includes six chapters. In the article, the author Edward Pegg noted about how to roll dice; the author also used some mathematical method, such as matrix to calculate the fairness of the dice. Since this article contains information related to my science research project, such as the fairness of the dice, I decided to read it over to have some idea about how other mathematicians organized their data to put onto paper and publish their work.

Hilton, P.J. & Pedersen, J. (1988). Building your own polyhedra. California, Addison Wesley Innovative Division.

6. This book provides me some helpful information related to my project, such as the layouts of the polyhedra and some mathematical relationships between the faces, vertices and edges of those polyhedra.

Holden, A. (1971). Shape, space, symmetry. New York: Columbia University Press.

7. This book talks about the shape, space and symmetry as its title states. It shows different polyhedra people have discovered since the ancient time. The book provide detail information about polyhedra in different categories, and the polyhedral duals.

Wenninger, M. J. (1971). Polyhedral models. Cambridge University Press.

8. This book talks about the polyhedra's mathematical classification at the beginning, which I think is the most important part I need to learn from this book.

Pugh, A. (1976). A polyhedral visual approach. University of California Press.

Diaconis P. & Holmes S. & Montgomery R. Dynamic bias in the coin toss. Stanford University and University of California Santa Cruz. Retrieved at October 16, 2006 http://www.stat.stanford.edu/~susan/papers/headswithJ.pdf#search=%22Persi%20Diaconis%20and%20the%20coin%20flipping%20machine%22