**Cube Folding**

**Objective:** The objective of this project is to experiment with different arrangements of six squares connected together and to discover which arrangements can be folded into a cube and which arrangements cannot.

**Concept:** The underlying goal is to have the kids discover the types of symmetry present in this system, like rotational symmetry and reflection symmetry, and to use the properties of symmetry to explain why certain patterns work and others do not without having to physically fold the squares. As such, this is almost purely mathematical in nature.

**Difficulty:** ★★★★★

This is a fun and easy to do project that can be expanded to be more difficult by trying the same approach with shapes that have more sides than a cube.

**Procedure:** Make up a few different arrangements of cubes, like the ones at the table, and try folding them into a cube shape. Try to make both shapes that will make a cube and shapes that will not, and then attempt to propose rules that will tell what kinds of other arrangements will or will not work based on your observations of the arrangements you tested.

**Analysis:** Use the rules you have created from testing a few arrangements and apply them to all the other possible arrangements. Use the concepts of various types of symmetry to explain why certain arrangements can be considered together as the same sort of arrangement, which will vastly cut down on the total number of arrangements that need to be considered.

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**Coin Game**

**Objective:** To analyze a simple game and determine if it is fair for both players.

**Concept:** “Unfair” games are games in which one player has an advantage over the other given a certain strategy. Students should attempt to determine if the game is unfair and if it is, what the winning strategy is.

**Difficulty:** ★★★★★

Easy to Hard depending on the student’s math ability.

**Procedure:** Play a couple games to get a feel for the dynamics. See if the number of coins or value of the coins affects who the winner is. Attempt to come up with a winning strategy. Develop a computer program to quickly run trials and determine if the strategy consistently works.

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**Balloons**

**Objective:** To determine the effect of a change in temperature on the shape of a balloon, and to explain why this occurs.

**Concept:** Thermal Expansion is the name of the game. The student will learn about how, as gases heat up, they expand, and as they cool they contract. This will cause a noticeable difference in the shape and “fullness feeling” of the balloon.

**Difficulty:** ★★★★

This is a simple project, and it is highly experimental. Some possible arrangements include:

- Filling up an even number of balloons, and measure them all, then leave half in the same room you inflated them in and put the other half in the freezer. After a short while, maybe an hour or so, take out the balloons in the freezer and observe the differences from the balloons you left alone.

**Analysis:** Compare the two ways of filling the box with candy and determine why one is more efficient than the other. Using this knowledge, you can show that one way is better than the other, at least for M&Ms.

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**Tower of Pisa**

**Objective:** To demonstrate center of mass location on a stable equilibrium, and to determine how this affects whether an object remains standing or falls over.

**Concept:** This is a physics project which stresses the concept of every object having a center of mass. That is, that every object can be treated as a single point that acts as if it contained the entire mass of the object. Using this knowledge, the student can determine at what angle a tower of their construction will finally topple over by using this center of mass concept, along with a little experimentation.

**Difficulty:** ★★★★★

Constructing a suitable tower and precisely testing angles is somewhat difficult, but really just requires diligence in the setup of the experiment.

**Procedure:** Build a tower on a level base (bonus points for making a scale model of the Leaning tower of Pisa) and then add more and more weight to one side of the tower by gluing something like cardboard to the side. Each time, check the angle of the leaning tower relative to the ground and record it in a table.

**Analysis:** Using the recorded table of added weight versus tilt, make a graph with added weight as the horizontal axis and angle of tilt as the vertical axis. At what point will the tower cease leaning and actually fall over? That is for you to find out!
Science Fair Extravaganza

http://www.iit.edu/~ipro330s07/

OUR WEBSITE - an invaluable resource for completing a science fair project.

PRESENTATION TEAM

guides, tips, and techniques

PROJECT TEAM

math & science fair projects bank

GOAL
Write up creative and detailed project ideas including: objectives, concepts, procedure, materials, analysis, pictures, etc.

Determine an appropriate definition of a math-centric project.

ORGANIZATION
Every member in the IPRO team contributed to project ideas, independently or through group brainstorming.

The project subteam organized itself in an efficient "parallel" arrangement, each member works project ideas into a detailed project individually.

A detailed project is then reviewed before its release to assure accuracy and consistency.

RESULTS
The project team came up with about a dozen different, math-centric projects in about eight weeks.

Projects cover different fields of science and range from easy problems that an average freshman student could handle, to challenging problems that involve more advanced mathematics knowledge, but still fully manageable with our hints and tutorials!

Each of the projects was completed by the team to produce pictures and ensure feasible results.

Achievements

We created newer, more interesting and math-focused projects for high school students throughout Chicago Public Schools.

We developed some presentation techniques ranging from presenting the data that the student found to presenting their findings orally to presenting their findings in written form on the board and in the form of a research paper.

We also created a website that not only portrays all the work that we accomplished over the semester, but also contains invaluable resources for students working on science fair projects.

Our IPRO now has contacts with CPS teachers and administrators which will prove valuable in coming semesters.

Future goals

This IPRO will be continued next semester with another group of students, and some current members of the team will continue to participate actively.

Future members of IPRO 330 will expand and improve on already posted projects and presentation guides, as well as add projects of their own.

The website will also need to be expanded and improved upon with increased content, and more interactive programs, based on further research and feedback from current Chicago Public Schools students and teachers.

Presenting projects and ideas for completing a science fair project.