MATH PROJECT INSTRUCTIONS

1. Focus on the topic for which you are going to do a math concept. It is important that you have a full understanding of the concept so that you can complete the project. If you don't know anything about the concept, or you aren't sure you understand it, get some books or find some information on the Internet about your subject.
2. Come up with an angle for your project. Even though it is a project about math, there are many different ways for you to do the project. You might write a paper, create a presentation, write a blog, shoot a video or even make a diagram or 3-D model of whatever your math concept or subject is. You'll need to decide which type of project you are doing before you can get started.
3. Figure out how your concept will fit into the angle you've chosen. For instance, if you are going to write a report and your concept is fractions, decide if you'd like to write about the history of fractions, how to work with fractions or even what fractions are used for in real life. If your concept is geometry and your project is going to be a 3-D model, decide which shapes you are going to make your models of and how the models will help you display the geometric concepts.
4. Gather the materials you'll need for your specific math project. Things like a computer, pencil and paper will be important if your project is a research paper. You might need clay, plastic or paper mache if you are making models. You will need presentation software or poster board if your project is going to be a presentation.
5. Find your research and create your project materials. Be sure that you follow your own plan, but also pay attention to what your teacher has assigned and asked you to do so you can be sure you complete it correctly.

The Math Project Display Board

Title

The title of your project should be a "catchy" phrase that makes people interested in reading more.

Example: "Snowflakes in July?", "Probably, Knot!", "Are you losing your marbles?"

Objective

The objective should explain why you have chosen this topic and the goal of your research. What are you trying to figure out or solve?

NJSLS (New Jersey Student Learning Standards)

The NJSLS can found online at the New Jersey Department of Education (NJDOE) website. Select "Mathematics", "Grade" and the standards will appear. Read through the standards to see under which one your topic will fall.

Research

Collect as much information as you can about your math topic. Spend some time in a library. The library is a great place to find information and to gain access to the internet. Make sure you take good notes. Your background research will help you understand your math topic.

Procedures

Records what you did to discover the solution to your math problem. Examples: Did you have to follow instructions on tying different kinds of knots? Did you have to draw and cut out three-dimensional figures?

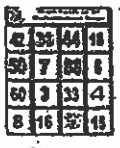
Materials
Did you use a ruler, protractor, compass, grid-paper, tiles, scissors, etc?

Cross-Content
How is your project related to other subject areas like social studies, science, art, music, etc?

Conclusion
Using your research and procedures, tell your findings. Give only facts to back up your conclusion or solution. Show all of your work and give a clear explanation.

All entries on the board must be typed. The display must be free-standing (able to stand on its own). The model must fit within the dimensions of the display board. (No live animals) You may use photos of your project taken during different stages of your project. The student's name (registration form) must appear **only on the back** of the project.

MATHEMATICS PROJECT
SCORING RUBRIC



ame: _____ Project Title: _____

chool/Teacher: _____ Grade: _____

	Criteria				Points
	4	3	2	1	
Explanation	A complete response with a detailed explanation.	Good solid response with clear explanation	Explanation is unclear	Misses key points	
se of Visuals	Clear diagram or sketch with some detail	Clear diagram or sketch	Inappropriate or unclear diagram	No diagram or sketch	
Mechanics	No math errors	No major math errors or serious flaws in reasoning	May be some serious math errors or flaws in reasoning	Major math errors or serious flaws in reasoning	
emonstrated Knowledge	Shows complete understanding of the questions, mathematical ideas, and processes	Shows substantial understanding of the problem, ideas, and processes	Response shows some understanding of the problem	Response shows a complete lack of understanding for the problem	
Counter Examples	Creatively integrates other content areas	Clearly integrates other content areas	Attempts to integrate other content areas	Does not clearly integrate other content areas	
				Total ------>	

OMMENTS:

Mathematics

- The mathematics of snowflakes
- Infinity comes in different "sizes". What does this mean? How can it be explained?
- Compare the mean, median and range of heights for males and females in your class. How will this compare to a class one year older?
- What is the probability of reaching into a bin and selecting a particular color of M&M candy?
- Demonstrate the bell shaped curved for random distribution
- Does a sphere hold a volume greater than the apparent volume of a cylinder?
- Is it possible to develop mathematical systems based on numbers such as 4 or 5 instead of the normal base 10 system we use?
- Fractals Encryption & Encoding
- Can parallax be used to measure distance to distant objects?
- How Does The Number Of Trials Performed Affect The Probability
- Demonstrate experimental methods of determining the value of pi.
- Research, explain and demonstrate the use of fractals.
- Determine how the size of a statistical sample affects its accuracy.
- Can statistics be used to predict the contents of edible consumer products such as fruit snacks, a bag of jellybeans or M&Ms?
- What equalities of lengths and angles are sufficient to prove two sets of four points (quadrilaterals or quadrangles...) are congruent?
- Build models showing that parallelograms with the same base and height have the same areas. (Is there a 3-dimensional analogue?) This can lead to a purely visual proof of the Pythagorean theorem, using a physical model based on dissections.
- Consider tiling the plane using shapes of the same size. What's possible and what isn't? In particular it can be shown that any 4-sided shape can tile the plane. What about 5 sides? Make sketches in a geometry program (Sketchpad, Cabri, or using Kali
- Investigate compass and straight edge constructions - showing what's possible and discussing what's not. For example, given a line segment of length one can you use the straight edge and compass to ``construct" all the radicals? Investigate constructions using origami (paper folding). Can you construct all figures that are constructed with ruler and compass? Can you construct more figures?
- What is the fewest number of colors needed to color any map if the rule is that no two countries with a common border can have the same color. Who discovered this? Why is the proof interesting? What if Mars is also divided into areas so that different countries on earth own these areas? They too are colored by the same rule but the areas there must be colored by the color of the country they belong to. How many colors are now needed?
- Polyominoes are shapes made by connecting certain numbers of equal-sized squares together. How many different ones can be made from 2 squares? from 3, from 4, from 5? Investigate the shapes that polynominoes can make. Play the ``choose-up" Pentomino game.
- Investigate the creation of secret codes (ciphers). Find out where they are used (today!) and how they are used. Look at their history. Build your own using prime numbers.
- Find out all you can about the Catalan Numbers, 1, 1, 2, 5, 14, 42, ...
- Build models to illustrate asymptotic results such as Stirling's formula or the prime number theorem.
- There is a well-known device for illustrating the binomial distribution. Marbles are dropped through the top and encounter a number of pins before dropping into cells where they are

distributed according to the binomial distribution. By changing the position of the pins one should be able to get other kinds of distributions (bimodal, skewed, approximately rectangular, etc.) Explore.

- Use Monte Carlo methods to find areas or to estimate pi. (Rather than using random numbers, throw a bunch of small objects onto the required area and count the numbers of objects inside the area as a fraction of the total in the rectangular frame).
- Look at the ways different bases are used in our culture and how they have been used in other cultures. Collect examples: time, date etc. Look at how other cultures have written their number systems. Demonstrate how to add using the Mayan base 20, maybe compare to trying to add with Roman numerals (is it even possible?) Explore the history and use of the Abacus
- There are several methods of counting and calculating using your fingers and hands. Some of these methods are still in common usage. Explore the mathematics behind one of them.
- Find out all you can about the Fibonacci Numbers - In particular, where do they arise in nature?
- What is the Golden Mean? Study its appearance in art, architecture, biology, and geometry, and its connection with continued fractions, Fibonacci numbers. What else can you find out?
- Investigate triangular numbers. If that's not enough, do squares, pentagonal numbers, hexagonal numbers, etc. Venture into the third and even the fourth dimensions.
- What is/are Napier's bones and what can you do with it/them?
- Discover how to construct the Koch or ``snowflake" curve. Use your computer to draw fractals based on simple equations such as Julia sets and Mandelbrot sets.
- Martin Gardner in defines a paradox to be ``any result that is so contrary to common sense and intuition that it invokes an immediate emotion of surprise." There are different types of paradoxes. Find examples of all of them and understand how they differ.
- Is there an algorithm for getting out of 2-dimensional mazes? What about 3-dimensional? Look at the history of mazes (some are extraordinary). How would you go about finding someone who is lost in a maze (2 or 3 dimensional) and wandering randomly? How many people would you need to find them?
- Investigate the Steiner problem - one application of which is concerned with the location of telephone exchanges to minimize costs.
- Construct a double pendulum and use it to investigate chaos.
- All forms of gambling are based on probability. Investigate how much casinos anticipate winning from you when you play blackjack, roulette, etc. Study a variety of lotteries and compare them. Should one ever buy a lottery ticket? Why does three of a kind beat two pairs in poker? Discover why the different types of hands are ranked as they are.
- Study the cycloid curve: its tautochrone and brachistochrone properties and its history. Build models.
- Investigate visual representations of different finite numbers. For example, if p is a prime with 100 digits, then if 1 and p are on the same line segment, with p say 6 inches to the right of 1, then $p^{1/2}$, the square root of p, is about 10^{-50} inches to the right of 1, less than one atom away. (And it's by inspecting the lattice points in the $p^{1/2} \times p^{1/2}$ array that one proves that p is the sum of two squares!) Investigate further.
- Investigate self-avoiding random walks and where they naturally occur.
- Find as many triangles as you can with integer sides and a simple linear relation between the angles. What about the special case when the triangle is right-angled?
- What is a hexaflexagon? Make, as may different ones as you can. What is going on?
- Build models to illustrate asymptotic results such as Stirling's formula or the prime number theorem.