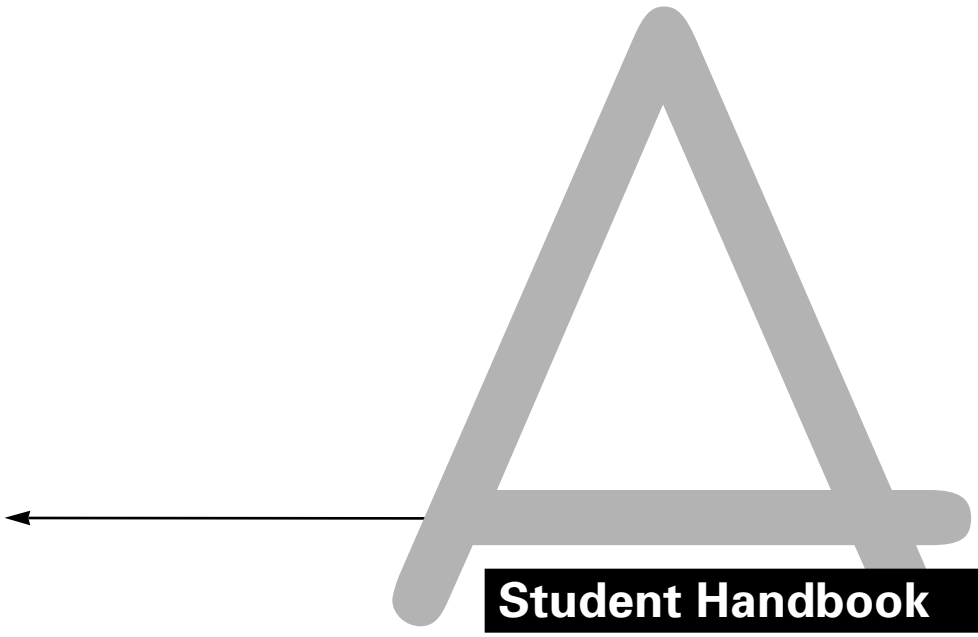

# Student Handbook


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Name: _____

# Choosing A Topic

As you think about your Math Fair project, your first task is to select a topic that interests you. The Suggested Topics list contains a number of math and math-related subjects that you can research and explore. Read through the list and find three choices that appeal to you. If you are intrigued by a topic but don't know much about it, visit the library or talk with an adult. Remember that these topics are only suggestions; if you have your own ideas, add them to the topics you have chosen from the list. Discuss your selections within your group and/or with an adult, and pick your favorite one.

Remember that your project must include:

- Research presented in written form
- Mathematical content
- Visual presentation of information (e.g., model, display and/or game)
- Oral explanation
- Opportunities for interaction with Fair visitors

Consider the components above as you choose your topic.

Your project should be neat, attractive and most importantly, informative. Be creative in your presentation. Visitors should learn something new by observing and participating in your project. You should be comfortable with your subject. Be prepared to explain and to answer questions about your project.

**My initial choices for a Math Fair topic are:**

a. _____

b. _____

c. _____

Name: _____

# Project Intros

These Project Intros are topics that require research, development and a dash of creativity. They are intended as a jumping off point from which students may follow their interests in a variety of directions to create a Math Fair project.

1. **Mathematics of the Human Body**
   The statistics of human anatomy are interesting and rich. Chart the number of bones and muscles in the human body. Research the number of liters of blood pumped by the human heart, and compute how many liters this would be in an expected lifetime. Put together a percentage chart of the makeup of the human body, (e.g., water, bone, muscle). What trace minerals exist in our bodies?

2. **World Records in Sports**
   A math project analyzing a sports record would be fun. Find a sporting event that interests you. Consider the women's marathon, a running race with fairly new statistics but very interesting patterns. List by year the world record for the women's marathon and calculate the percent of improvement for each new record. Show the data with a graph. Predict the next two world records using the percent pattern you discover. Compare the women's data with the same information from the men's marathon. How do the percentage increases compare? Who has made more progress dropping the record time? Explain why you think this might be so.

3. **The Principal's Office Project**
   Ask permission to measure the width, length, and height of the principal's office (or the library, art room, or gym). Calculate the volume of the space in cubic units. Now calculate the number of dominoes, Pez candies, or liters of water it would take to fill the space. Design a scale model of the space and chart your calculations.

4. **How Many Blades of Grass?**
   Estimate the number of blades of grass on your front lawn, the soccer field of your school, the domed football stadium in the next town, or the playground in your city. Go to the spot and measure the length and width of the space. Calculate the area in square units by multiplying the two dimensions. Use a ruler, four toothpicks and some string to plot out a perfect 1 inch by 1 inch or 2 centimeter by 2 centimeter square. Carefully lift the sod from the field and count the number of grass blades. Using this method of sampling, estimate how many blades might exist on the total space. Chart other ways sampling might work for estimation (e.g., the number of fish in the lake, the number of seeds in the watermelon).

5. **Enlarge a Masterpiece**
   Select a famous painting, such as Leonardo's *Mona Lisa* or Van Gogh's *Sunflowers*. Copy a print and divide it into 1 inch by 1 inch squares (2 centimeter by 2 centimeter squares will also work). Name each square by a horizontal letter and a vertical number (e.g., A2, B6). Now construct an enlargement of the print by multiplying the 1 inch length and the 1 inch width by 5. Cut the print into the small squares and pass them out to classmates. Ask them to reproduce the "art" from their small square onto the 5 inch by 5 inch square you give them. Reassemble the enlargement on the day of the Fair and display it along with a copy of the original print of the painting.

Name: _____

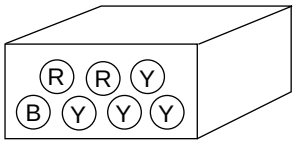
# 1 • Dice-y Probability

**Background Information**

Probability is a branch of mathematics that studies and describes "chance." Probability has applications in areas such as genetics and insurance.

The probability of an event (P) is a measure of the likelihood that the event will occur. An impossible event has a probability of 0. An event that is certain to occur has a probability of 1 or 100%. If an event is equally likely to occur (*favorable outcome*) as not to occur, we say that the probability of its happening is 1/2 or 50%. To find the probability that an event will be "favorable," divide the number of ways that it can occur favorably by the total number of ways that the event can occur.

$$P = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$




Example: If a box has 2 red, 1 blue, and 4 yellow marbles, the probability of drawing a red is 2/7; the probability of drawing a blue marble (if you replace the red one) is 1/7. The sample space is a list of all possible outcomes. For the example above, the sample space is {red, blue, yellow}.

**Mathematical Explorations**

*Experiment*

Use two regular (*6-sided*) dice. Roll them 20 times and record the sum of the two faces showing. Does it appear that all sums (*outcomes*) are equally likely? To see a pattern more clearly, try rolling the dice 100 or more times.

To explain the results of experiments such as this, it often helps to create a list of all possible outcomes. Use this chart to record all possible sums (*outcomes*) of your dice experiment.

Possible Sums

Die 1 →

Die 2 ↓

| + | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | 5 | | | | | |
| 5 | | | | | | |
| 6 | | | | | | 12 |

Name: _____

Now list the number of ways that each sum can occur *(the number of times that it appears in the Possible Sums chart)*.

| Sum | Number of Ways | P(x)= |
|---|---|---|
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | 6 | $P(7)=\frac{6}{36}=\frac{1}{6}$ |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | 1 | |
| 12 | | |

You can use probability to explain why some sums occur more than others.

The number 7 appears in the chart six times. The total number of possible outcomes is 36. You can say that $P(7) = \frac{6}{36} = \frac{1}{6}$. Fill in the P(*x*) = column of the chart above.

*Creating a Graph*

For your display, visitors can participate in creating a graph showing the outcome of rolling three dice. You will need three ordinary dice, a large piece of grid paper (about 2 feet by 3 feet), and markers or stick-on dots.

Before the Fair, prepare the graph by marking all of the outcomes (*3 through 18*) along the bottom. Give your graph a title such as "Sums of Three Dice." *(See following diagram on page 7.)* Your actual graph should contain additional rows. When people visit your exhibit, they may roll the dice and add this data to your graph by placing an X or stick-on dot in the appropriate column. By the end of the Math Fair your graph should show a clear pattern of outcomes.

Name: _____

## Sums of Three Dice

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

Create a chart showing all the ways to get each sum.

For example, the sum of 4 can be reached by rolling 3 dice in these three configurations:

1 + 1 + 2 1 + 2 + 1 2 + 1 + 1

You will need a systematic approach to find all of the possible ways.
Check: You should have 6 x 6 x 6 = 216 entries in your chart because there are 216 ways to reach the sums of 3 through 18 by rolling three dice.

**Extensions**

- You can also use coins or spinners to conduct experiments and create games. Create a sample space for each game to show all possible outcomes.

  *Four Coin Game 1:*
  Toss four coins. You win if there are an equal number of heads and tails. Otherwise your friend wins. Is this a fair game?

  *Four Coin Game 2:*
  Toss four coins. You win if there is exactly one head or one tail. Otherwise your friend wins. Is this a fair game?

- Create real-life situation problems. Put them on a chart to challenge visitors at the Math Fair.

  *Example*
  There are twelve boxes of cereal on the shelf. Three are mueslix, four are wholegrain, and five are sugar-coated. If John picks one box at random, what is the probability that he will pick a box of muselix?