STEM Sims™

# Multicolored Dice

STEM Sims™

# Multicolored Dice

## Do you need an idea for a scientific study? Try out one of our ideas or make one of your own.

**Start learning right now about how probability and statistics are very important topics that help in your science studies. Take the following brief quiz to see how much you already know about solving some simple probability problems.** See the bottom of page 4 to check your answers.

1. A family has two children. Make up a list of the combinations of Boy-Girl in the family. This type of listing is known as a "sample space." The sample space should be of the form (First Child - Second Child). *Check the bottom of this section for the correct answer before continuing.*

2. To solve the following two problems use the sample space you made for problem #1. Cross out the events that are NOT possible and count the ones remaining. Next see how many of these meet the conditions of the problem.
   a. A family has two children. One child is a boy. What is the probability that the other child is a girl?
   b. Suppose you are told that the FIRST child is a boy, what is the probability that the other child is a girl?

3. Hannah flips a fair coin three times. Set up the sample space for this problem - all possible combinations of HEADS and TAILS. Remember that (HTH) is a different outcome than (HHT).
   a. What is the probability that HEADS shows up all three times?
   b. What is the probability of Hannah getting *at least* 2 TAILS in the three flips?
   c. If the first coin toss is a TAIL what is the probability of getting three TAILS?

4. Suppose you know that there are four events in a probability problem A, B, C, and D. If the chances of A is 25%, of B is 30%, and of C is 35% -- what is the value for D? Why?

5. Suppose that a lottery ticket has you pick 6 numbers from 1 - 40. Which of the following is the most likely to win? Which one is the least likely to win?
   a. (1, 2, 3, 4, 5, 6)
   b. (12, 23, 28, 30, 33, 38)
   c. (35, 36, 37, 38, 39, 40)


Answer: Question 1) { (Boy-Boy) (Boy-Girl) (Girl-Boy) (Girl-Girl) }

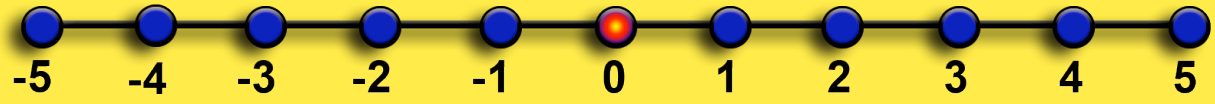
# Take a Chance!

If you have ever watched a butterfly fly around in your back yard, you probably have noticed how complicated the movement seems. The molecules of the air that you are breathing move in a similar way. This type of motion is called a "Random Walk."

### Exercise 1 - A One-Dimensional Random Walk

Draw a line and mark it in even intervals from -5 to +5 (from left to right)

Start the experiment at point "0" and toss a coin. If the coin comes up HEADS move one step to the right. If the coin comes up TAILS move one step to the left.



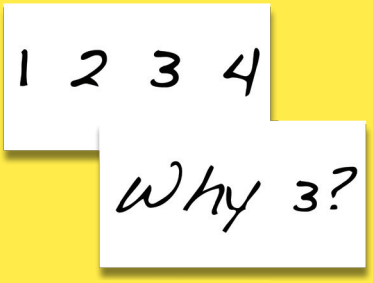

a) If you flip the coin five times, what are the chances of ending up at either -5 or +5?
b) What is the chance of ending up at point FOUR?

When you try this, you will notice that sometimes you go much farther than you expect and sometimes you end up very close to where you started. But if you repeat it many times or get several of your friends to do it with you with coins of their own, the average distance should come out as expected. In science we can often predict what will happen on the average even when the process is random.

---

### Exercise 2 - Just 4 Fun

For this exercise you need to prepare a card with the numerals 1, 2, 3, and 4 on one side and the words "Why 3?" on the other side.




Show the card (the side with the numerals, of course) to someone and ask them to pick a number - then ask them to tell you the number. If they say "3" then show them the other side of the card. If they pick something other than "3" just say "Thank you" and move on.

---

### Exercise 3 - A Problem With Several Different Correct Answers

Most of the problems we see in mathematics textbooks are solved using basic operations and calculations and lead most of us to believe that there is only one way to solve a given problem. Here is a problem that can have a number of correct answers:

Which number is different in the following set? Explain your answer.

**{25, 65, 51, 53, 93, 135, 55}**

The answer should be mathematical in nature and not a statement like "25" is the only 25 in the listing."

Please visit our site for more helpful information:
**STEMsims.com**

# Multicolored Dice

## Some More Math For You

Probability is a number and can be expressed as a fraction, a ratio, a decimal, or a percent. The number is determined by first listing all of the possible events that can occur. Then we choose an event and count the number of times the event is true and divide by the total number of possible and likely events.

$$\text{Probability of an event happening} = \frac{\text{Number of times it can happen}}{\text{Total number of outcomes}}$$

If you were to roll a die, there are six possible outcomes - {1, 2, 3, 4, 5, 6}. The probability of rolling a 5 is 1/6 and we would write this as P(5) = 1/6. Likewise, the probability of rolling an even number would be P(even) = 3/6 = 1/2.

The probability of an event can range from 0 (impossible) to 1 (certain). The probability of rolling a number greater than 6 using a fair die is 0 and the probability of rolling a number less than 10 is 1.

With two simple rules, we can solve a number of probability problems. If P(A) = X and P(B) = Y then P(A or B) = X + Y and P(A and B) = XY.

---

Try these two problems *(problem 2 is a little tricky)*

1. What is the probability of rolling a SIX on a die AND then getting a HEADS on a coin flip?

2. In a box there are A green balls, 3A + 6 red balls, and 2 yellow balls. If there are no other colors in the box, what is the probability of picking out a green or a yellow ball?

---

**Answers:** **Page 2 Answers:** 2) (a) {Girl-Girl} is removed - of the three remaining, two of them have a girl as the second child - probability is 2/3; (b) probability is 1/2, 3) P(HHH) = 1/8. P(2T) = 3/8 P(TTT) = 1/8 P(at least 2T) = 3/8 + 1/8 = 1/2 (HHH, HHT, HTH, THH, HTT, THT, TTH, TTT), 4) probability cannot exceed 100% so P(D) = 20%, 5) Believe it or not, the chances of each of these choices is exactly the same. **Page 3 Answers:** Exercise 1) (a) P(TTTTT) + P(HHHHH) = 1/32 + 1/32 = 2/32 = 1/16, (b) P(-4) + P(4) = 1/16 + 1/16 = 2/16 = 1/8, Exercise 3) Examples; 25 is the only perfect square, 93 is the only one without a 5, 135 is the only three digit number. **Page 4 Answers:** 1) P(6) = 1/6 P(H) --- P(6 AND H) = (1/6)(1/2) = 1/12, 2) There are A + 2 Green and Yellow balls in the box. There are (3A+6) + (A+2) = 4A + 8 Green, Yellow and Red balls. P(G or Y) = (A+2) / (4A+8) = (A+2) / 4(A+2) = 1/4.

The Science Fair Kits project was funded in part under the Department of Homeland Security Science and Technology Directorate grant contract #N10PC20003. Its contents are solely the responsibilities of the authors and do not necessarily represent the official views of the Department of Homeland Security.