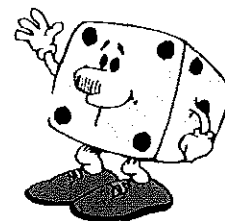
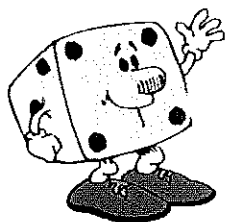


# ***Possibilities***

## ***with***

# ***Probability***



**Betsy Shipper**

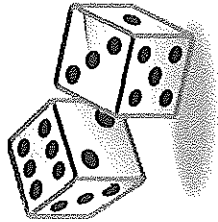
**ashipp@math.rice.edu**

**Susan Troutman**

**troutman@rice.edu**

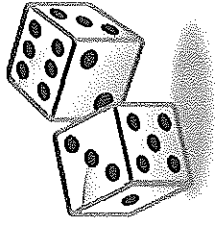
**For handouts:**

**<http://rusmp.rice.edu/>**



# ROLLO

## A Two-Dice Game



### Directions:

- Players place all eleven counters on their number line in any way they like. They may put more than one counter on each number.
- The teacher will roll a pair of dice (or number cubes) and call out the sum that comes up.
- Players may remove only one counter for each time the sum is rolled.
- The winner is the first player to remove all of their counters and call "Rollo."

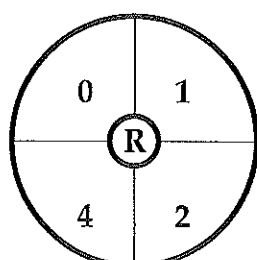
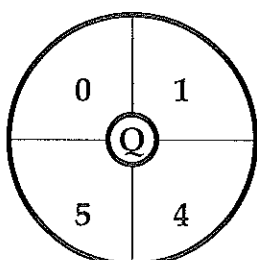
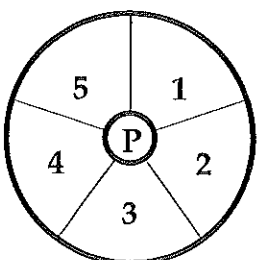
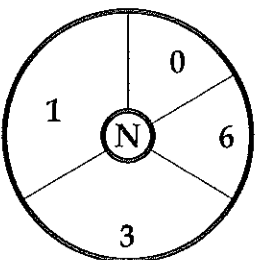
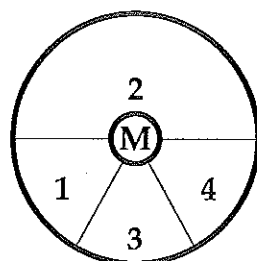
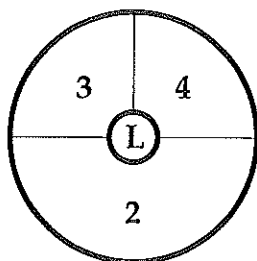
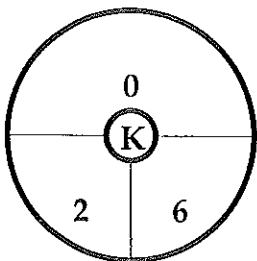
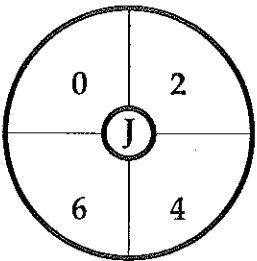
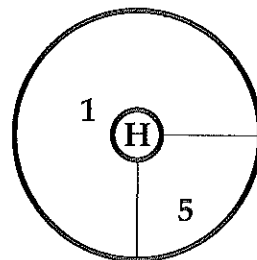
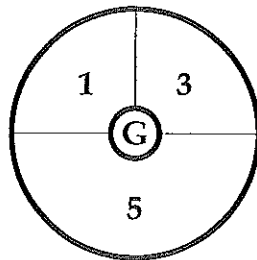
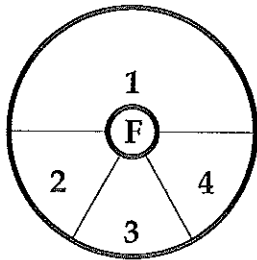
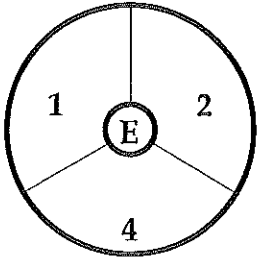
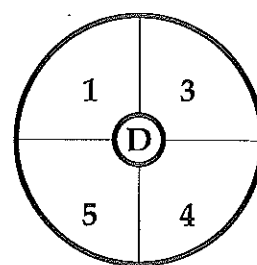
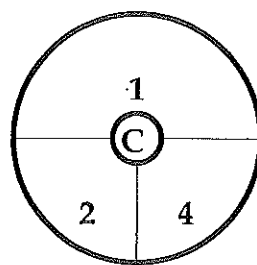
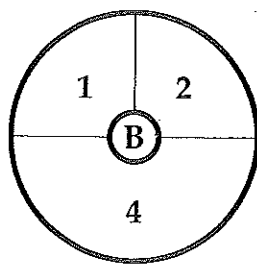
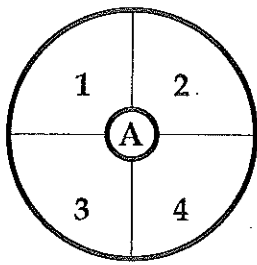
1 2 3 4 5 6 7 8 9 10 11 12

## ROLLING WITH PROBABILITY

**Directions to play:** With a partner, take turns rolling a number cube. Use the number shown on the number cube as the denominator of a fraction. The numerator is always 1. For example, if you rolled a 2, the fraction would be  $\frac{1}{2}$ . Find a situation on this sheet that has a probability equal to that fraction. All fractions should be in simplest form. Put your marker on that spot. The winner is whoever gets three markers in a row in any direction.

**Materials:** a number cube, markers or place holders of two different colors

Rolling a 2 on a number cube	Selecting a boy out of an equal number of girls and boys	Selecting one of the mice out of the Three Blind Mice	Selecting a red card from a deck of cards
Tossing heads on a coin	Selecting summer out of the four seasons	Selecting a vertex of a triangle	Selecting heads or tails on a coin
Selecting Joe out of Jim, Joe, Jan, or Jill	Selecting an even number out of 2, 4, 6, and 8	Selecting a girl from Tom, Jill, Dan, or Joe	Selecting a vowel from the word "dice"
Selecting one of the pigs out of the Three Little Pigs	Selecting the letter A in the word "A"	Selecting May from the months of January through June	Rolling a 2 or 3 on a dice
Selecting blue out of red, blue, black, yellow, or green	Selecting an odd number on a dice	Selecting the letter E out of the letters in the word BEST	Selecting an even number out of 1, 3, 5, 8, or 9
Choosing one corner of a hexagon	Selecting the letter A in the word ACTION	Selecting an odd number from 1, 3, 5, or 7	Choosing the front tire out of the tires on a bicycle



# Spinner Sheet

## A-H Spinners!

If you spin once, you can never get a 3.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!



## A-H Spinners!

The chances of spinning a 2 are the same as the chance of spinning a 1.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!

## A-H Spinners!

There are three numbers on the spinner.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!

## A-H Spinners!

If you spin this spinner twice and add, you can get a 5.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!

## A-H Spinners!

If you add all the numbers on the spinner, the sum is less than ten.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!

## A-H Spinners!

All the numbers have an equal chance of coming up.

Which spinner is it?

The spinner is one of the spinners between A and H on the spinner sheet. Use your clue to help the group figure out which one!

## Spinners JR

You can't make a sum of ten in two spins with this spinner, but you can do it in three.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!



## Spinners JR

It's possible to get a one when you spin this spinner.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!

## Spinners JR

There is less than a 50% chance that you will spin a two in one spin.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!

## Spinners JR

The numbers on the spinner are *not* equally likely to show up.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!

## Spinners JR

It's possible that after 100 spins, the sum of all your spins will still be zero.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!

## Spinners JR

If you spin this spinner twice, the numbers will sometimes add up to two.

The spinner is one of the spinners between J and R on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #1

It's impossible to spin a two in one spin with this spinner.

Which spinner is it?

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!



### Which Spinner #1

You'll never get a six with this spinner in one spin no matter how long you try.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #1

The chance of spinning a five is not the same as the chance of spinning a one.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #1

If you spun this spinner 100 times you'd probably get only twenty or thirty fives.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #1

If you spun this spinner 100 times and added up all the numbers, you'd probably get about 200.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #1

If you spun this spinner twice and added, you'd never get a five.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #2

It is not possible to spin a sum of seven in two spins with this spinner.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!



### Which Spinner #2

It is possible to get a ten with this spinner in two spins if you add the numbers.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #2

The chance of a spinner landing on a three in two spins with this spinner is zero. No chance at all.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #2

There are more ways to get a sum of five in two spins than a sum of one in two spins.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #2

In a hundred spins, the sum of the numbers you'll get is about the same as for spinner A.

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!

### Which Spinner #2

There are four numbers on this spinner.

Which spinner is it?

The spinner is one of the spinners on the spinner sheet. Use your clue to help the group figure out which one!



NAME \_\_\_\_\_

# The Hare and the Tortoise Game

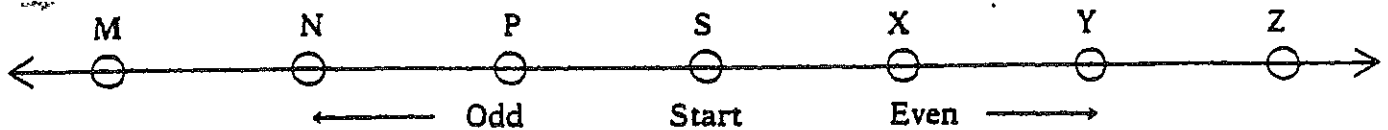
## Materials

Game board, a marker (bobby pin), and a die for each player.

## Game Rules

1. The tortoise and the hare start *each turn* at S.
2. Each turn consists of three moves. The player will roll a die a total of three times per turn. After each roll, the player's marker is moved one place to the left if the number on the die is odd and one place to the right if the number on the die is even.
3. Scoring: The tortoise gets a point if at the end of the three moves the marker is on position P or X. The hare gets a point if the marker ends at position M, N, S, Y or Z.
4. Players alternate turns until *each* has had 16 turns.
5. To start play: Each player rolls a die. The highest number chooses a character, hare or tortoise, and takes the first turn.

## Game Board



## Record Sheet

As you play the game, record where you land at the end of each turn by putting a tally mark in the appropriate space.

Position Play Ends	Hare—16 turns	Tortoise—16 turns	Totals for all 32 turns
P			
X			
M			
N			
S			
Y			
Z			

Hare scored \_\_\_\_\_ points. Tortoise scored \_\_\_\_\_ points.

What is the probability that a player ends at position P?  $P(P) =$  \_\_\_\_\_

At position X?  $P(X) =$  \_\_\_\_\_

At position S?  $P(S) =$  \_\_\_\_\_

At position M?  $P(M) =$  \_\_\_\_\_

At position Y?  $P(Y) =$  \_\_\_\_\_

At position N?  $P(N) =$  \_\_\_\_\_

At position Z?  $P(Z) =$  \_\_\_\_\_

Name \_\_\_\_\_



# SCISSORS, ROCK, PAPER ?

Predict which player will win the game **A**, **B**, or **C** ?

These are the game rules :

**Player A** receives 1 point if all three players display the same hand arrangement.

**Player B** receives 1 point if all three players display a different hand arrangement.

**Player C** receives 1 point if any two players display the same hand arrangement.

Play 27 games and tally the points on the chart.

Record the tally for the experimental probability.

TALLY	EXPERIMENTAL PROBABILITY ( $T/27$ )	PER CENT
Player A	$\frac{\quad}{27}$	
Player B	$\frac{\quad}{27}$	
Player C	$\frac{\quad}{27}$	

**A.** Which player was the winner of the 27-turn set ?

**B.** Was your prediction of the winner correct ?

**C.** How many points did each player get in the 27-turn set ?

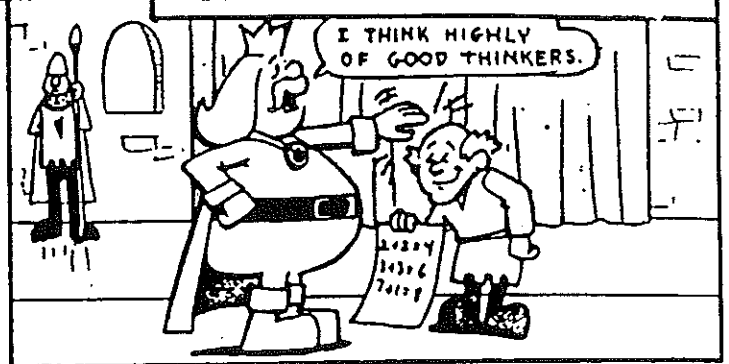
Player A \_\_\_\_\_ Player B \_\_\_\_\_ Player C \_\_\_\_\_

THE  
STORY  
IS  
TOLD  
THAT:

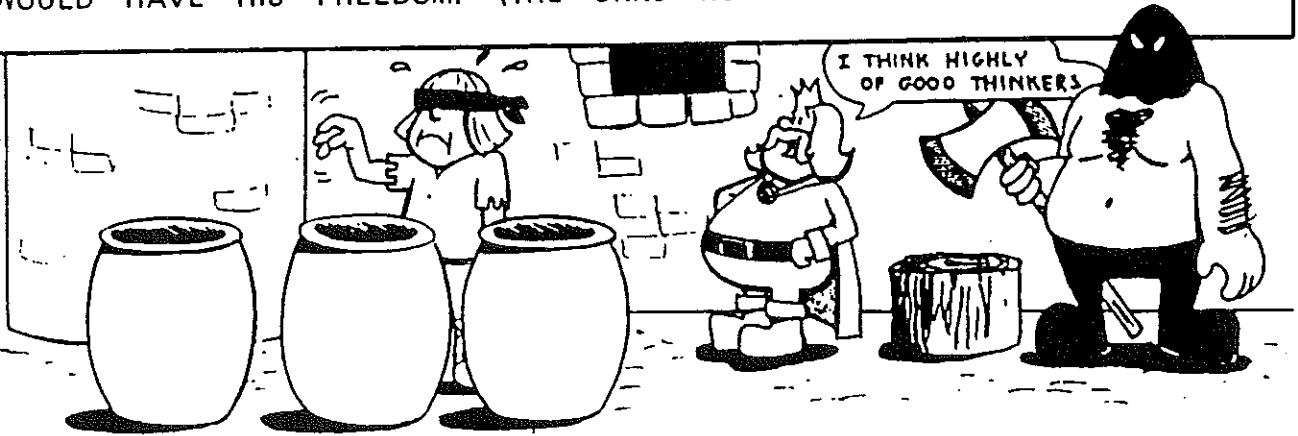
MANY YEARS AGO IN THE FAR  
OFF LAND OF CHANZANIA, A  
PRISONER WAS TO BE EXECUTED.



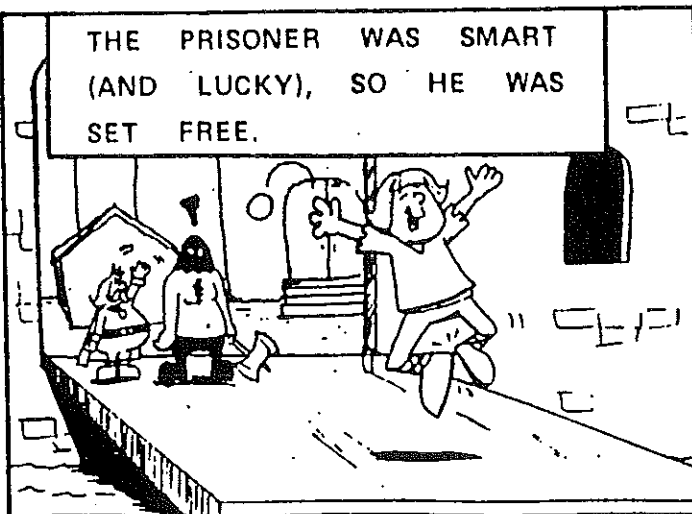
THE KING OF CHANZANIA  
WAS A SPORTING FELLOW  
WHO THOUGHT HIGHLY OF  
GOOD THINKERS.



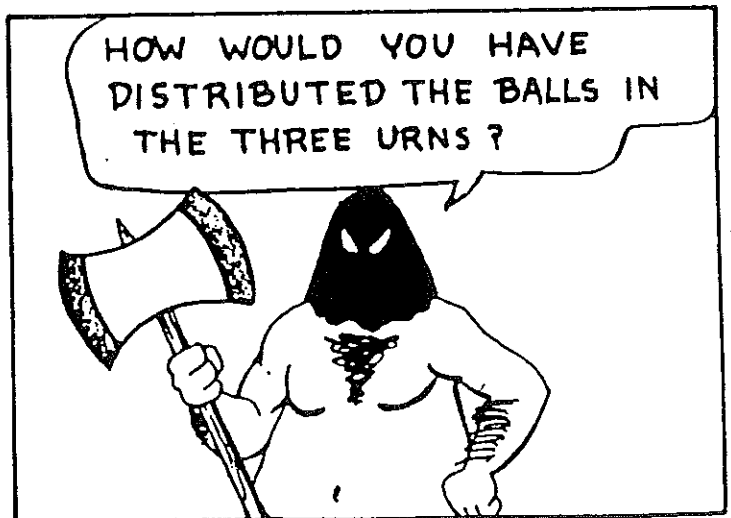
THE KING OFFERED THE PRISONER A CHANCE FOR FREEDOM.  
HE WAS GIVEN 100 BLACK BALLS AND 100 WHITE BALLS, AND WAS  
TOLD TO DISTRIBUTE THEM INTO THREE SIMILAR URNS IN ANY  
WAY HE LIKED. HE WAS THEN BLINDFOLDED AND TOLD TO DRAW  
A BALL AT RANDOM FROM ONE OF THE URNS. IF HE DREW A BLACK  
BALL HE WOULD BE EXECUTED. IF HE DREW A WHITE BALL, HE  
WOULD HAVE HIS FREEDOM. (THE URNS WERE REARRANGED.)



THE PRISONER WAS SMART  
(AND LUCKY), SO HE WAS  
SET FREE.



HOW WOULD YOU HAVE  
DISTRIBUTED THE BALLS IN  
THE THREE URNS?



## References

Erickson, T. (1989). *Get it together: Math problems for groups grades 4-12*. Berkeley, CA: Equals

Lawrence Hall of Science.

Geringer, L. (1985). *A three hat day*. New York, NY: HarperCollins

Murphy, S. J. (2003). *The sundae scoop*. New York, NY: HarperCollins.

Schwartz, D. M. (1998). *G is for googol: A math alphabet book*. Berkeley, CA: Tricycle Press.