

www.boxcarsandoneeyedjacks.com

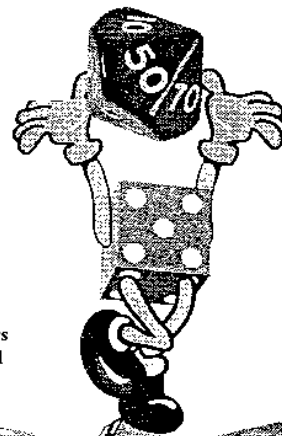
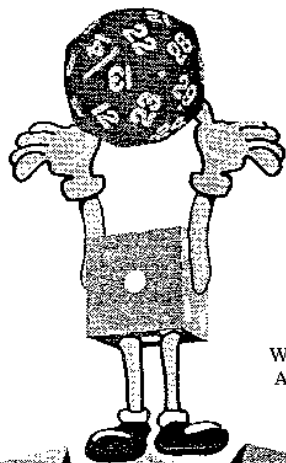
# box cars and one-eyed jacks®

1-866-342-3386

## Probability Fun "Die" Mentals

Odds Are.... You will love this workshop!

John Felling  
Middle Years Data Management & Probability  
Ft. Worth, TX, June 2011



All rights reserved.

Except as noted, no part of this publication may be reproduced or transmitted in any form or by any means without the prior written or verbal permission of Box Cars And One-Eyed Jacks Inc.

Written permission must be obtained and a licensing fee issued through Box Cars And One-Eyed Jacks Inc. for the sole purposes of inservicing other professional educators or parent communities.

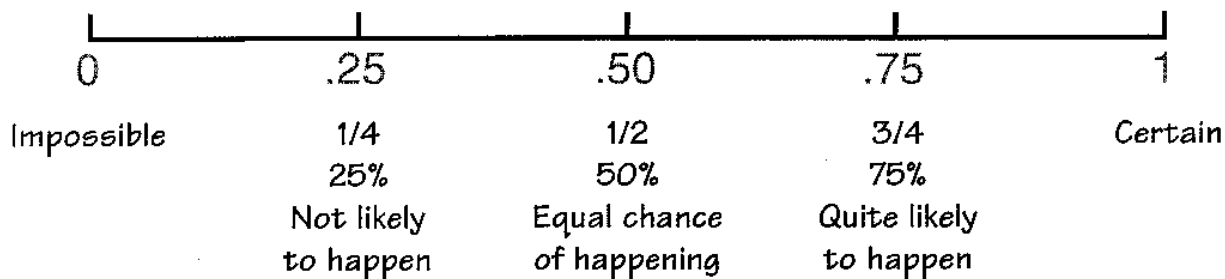
# What Is Probability?

*PROBABILITY is about possible outcomes... no guarantees. It is the likelihood of a particular outcome. In mathematical terms, it is the ratio of the number of times a particular outcome occurs to the total number of outcomes.*

1) Theoretical Probability -- "in theory"

2) Experimental Probability -- "what really happens"

## THE SCALE



What the "Experts" have to say...

**Kids Just Know  
How to Explain It!**

"I know what probability means:  
how many times  
something will occur."

-- Gr. 8 Matt J.

"Probability is in a lot of things like the  
following: the lottery, the weather,  
contests and dice/spinner games."

"I like probability ok because it's pretty much just putting  
2 numbers together and badda-bing-badda-boom --  
probability is born. It's logic."

-- Gr. 7

"I think that probability means solving  
problems, chance. What will probably  
happen."

-- Gr. 4

# HORSE RACE

4 LEVELS  
OF  
PLAY

2 DICERS  
2 PLAY

This is a game for two Dicers to play at one time. Players use one tray divided so that each player uses only their half.



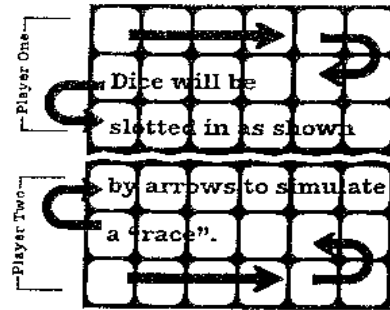
## TO BEGIN

Each Dicer chooses eighteen dice of their own colour and these are removed from the tray.

## THE GOAL

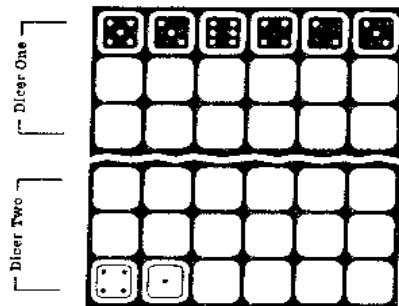
The goal of the game is to have the most dice in your side of the "horse race track" after all dice have been rolled out for the round. Dicers roll two dice at one time.

Dicers add their two dice and compare their sums. The Dicer with the greatest sum places them into their side of the "horse race track". Their opponent places their two dice into the lid (losing side). Dicers pick up two new dice, roll, add and compare their sums. The Dicer with the greatest sum places them into their side of the "horse race track" and their opponent places them into the lid. In the event of a tie sum, both Dicers place their dice into their own side of the "horse race track". Dicers roll out all remaining dice. The Dicer with the most dice on their side of the "horse race track" after nine tosses, is the winner.



The tray is divided between the two players as shown.

## EXAMPLE



Play After 3 of 9 Rounds.

### Toss 1

Dicer One + = 8 → WINS and places dice in tray

Dicer Two + = 5 → Tosses dice into lid

### Toss 2

Dicer One + = 10 → WINS and places dice in tray

Dicer Two + = 3 → Tosses dice into lid

### Toss 3

Dicer One + = 5 → TIE both players place dice in tray

Dicer Two + = 5

## LEVEL 1

Play is outlined above, Dicers roll two dice and add.

## LEVEL 2

Play as described in above rules, but now Dicers roll three dice and add for the greatest sum. The Dicer with the greatest sum (answer) places them into their side of the "horse race track".

$$\begin{matrix} \blacksquare & + & \blacksquare & + & \blacksquare & = & 9 \end{matrix}$$

## LEVEL 3

Play as described in above rules, but now Dicers roll two dice and multiply  $\blacksquare \times \blacksquare = 20$  for the greatest product. The Dicer with the greatest product (answer) places them into their side of the "horse race track".

## LEVEL 4

Play as described in above rules, but now Dicers roll three dice, add two, and multiply by the third for the greatest product. See example.

The Dicer with the greatest product places them into their side of the "horse race track".



$$(5 + 3) \times 6 = 48 \checkmark \text{ Best Choice}$$

$$(6 + 3) \times 5 = 45$$

$$(6 + 5) \times 3 = 33$$

You will have to do some thinking here to create the best possible answer for your roll. Will there always be 3 possible answers?

GOOD LUCK!



# Games Outcomes Chart

After each game, record what type of finish you had (use tally marks like IIII)

Blow Out	Close	Dead Heat (Tie)
Total Blow Outs	Total Close Races	Total Ties (Dead Heats)

# BIG SUMS



**SKILLS:** Problem solving, gathering data, recording data, interpreting data

**PLAYERS:** Students work in groups of 2, 3 or 4

**EQUIPMENT:** 36 regular dice per group, paper and pencil, chart

**ACTIVITY I:** The goal of the activity is to find the sum of 36 dice after they have been rolled.

**TEACHING TIP:** Allow students several rounds to develop their own method of adding the dice. Use **Chart I** to record the methods. Teach the patterns below and show the students how to group the dice.

1	2	6
2	4	7
3	6	8
<u>+4</u>	<u>+8</u>	<u>+9</u>
10	20	30

**THOUGHT PROVOKERS:**

1. What is the most efficient pattern to start with? Why?
2. In which order should we use the patterns to be most efficient? Why?
3. What is the largest sum we could have? What is the smallest?

**ACTIVITY II:** The goal is the same but we are trying to determine the range of possible sums. Use **Chart II** to record the sums that are used.

**THOUGHT PROVOKERS:**

1. What is the estimate for the mean value of the sums?
2. Can anyone give an explanation for the mean?
3. (Challenger) What is the mean sum of 48 dice?

**CHART I:**

	Prediction	Method Used	Actual Sum	+ / - Difference
1.				
2.				
3.				
4.				
5.				

**CHART II:**

150+	141-150	131-140	121-130	111-120	101-110	90-100

# ROLL'N ON PLACE VALUE

Copyright Box Cars And One-Eyed Jacks Inc.



## TO BEGIN

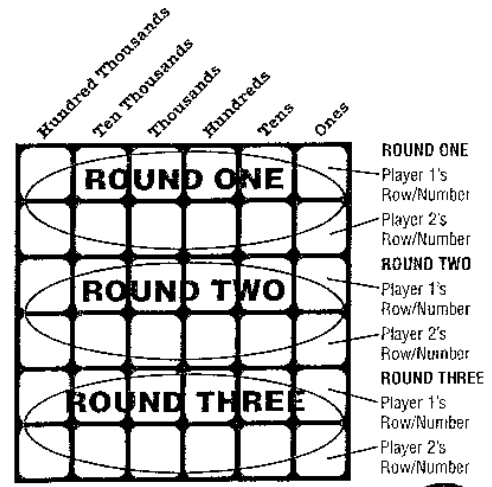
Dicers select their own colour of dice. The dice will be rolled alternately one at a time by the players throughout the game. A total of three rounds will be played (see example 7).

## THE GOAL

The goal of the game is to be the player who creates the largest six-digit number in each round.

## TO WIN

A Dicer must be the first one to win two out of three rounds. To start the first round player number one rolls a die and selects the best place value position in their row. For example, if player one rolls a two, the "tens" position might be selected. Player two now might roll a five and place it in the "ten thousands" position of their row. Once a die is placed in any place value position it cannot be moved. Remember, this is a game of chance. It depends on chance whether you throw the number you want on the die. Be a risk-taker and make a calculated guess. The more you play, the better you'll play. Players alternate taking their remaining five rolls, each building their own hundred thousands number - keeping in mind the goal of the game is to create the largest number possible.

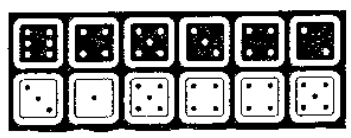


Example 7



# ROLL'N ON PLACE VALUE (CONTINUED)

- Player 1 rolls a 5
- Player 2 rolls a 4
- Player 1 rolls a 3
- Player 2 rolls a 4
- Player 1 rolls a 6
- Player 2 rolls a 5
- Player 1 rolls a 4
- Player 2 rolls a 5
- Player 1 rolls a 2
- Player 2 rolls a 1
- Player 1 rolls a 4
- Player 2 rolls a 3



Example 8

Once all dice have been placed, players say their numbers out loud and compare them to determine which player has made the greatest hundred thousands number. This Dicer wins that round. In example 8, player one wins round one. Play continues into round two and if necessary a third round is played to determine the overall winner.

## VARIATION I

To decrease the level of difficulty players may roll less dice ie., only four dice per player to build a thousands number or three dice each to build a hundreds number.

## VARIATION II

Dicers can agree to change the goal of the game and now attempt to build the smallest six-digit number in each round. A roll of 1 or 2 is now considered a "nice dice" roll! The lowest number you could possibly roll would be 111,111. What would the probability of that be?

Player one's number is 645,342 which beats player two's number 315,445.





# Flippin' Out

00	10	20	30	40	50	60	70	80	90	100
----	----	----	----	----	----	----	----	----	----	-----

Tens

Ones

Tens

Ones

Player One

Player Two

000 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | >

Copyright Box Cars And One-Eyed Jacks Inc.

Hundreds

Tens

Ones

Hundreds

Tens

Ones

**Player One**

**Player Two**







# Biased Dice



Theoretical Probability indicates it's expected there would be an equal number of rolls of each value if there are no other variables affecting the outcome. For example, if rolling a six-sided die, after many rolls, there would be an equal number of 6's, 5's, 4's, 3's, 2's and 1's rolled.

Experimental Probability indicates what actually happens. For example, if rolling a six-sided die, after many rolls, what were the actual number of 6's, 5's, 4's, 3's, 2's, and 1's rolled.

Bias for a die is evident if, after many rolls have been taken, Experimental Probability (actual) doesn't closely resemble Theoretical Probability (expected).

## Roll die #1, 120 times

After each roll, record the number rolled (use tally marks like IIII)

1	2	3	4	5	6
Expect 20	Expect 20	Expect 20	Expect 20	Expect 20	Expect 20
Actual	Actual	Actual	Actual	Actual	Actual

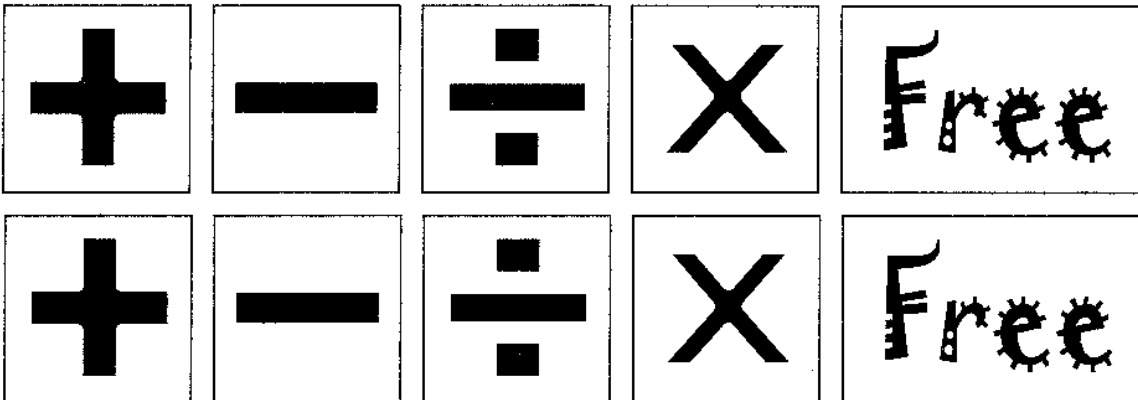
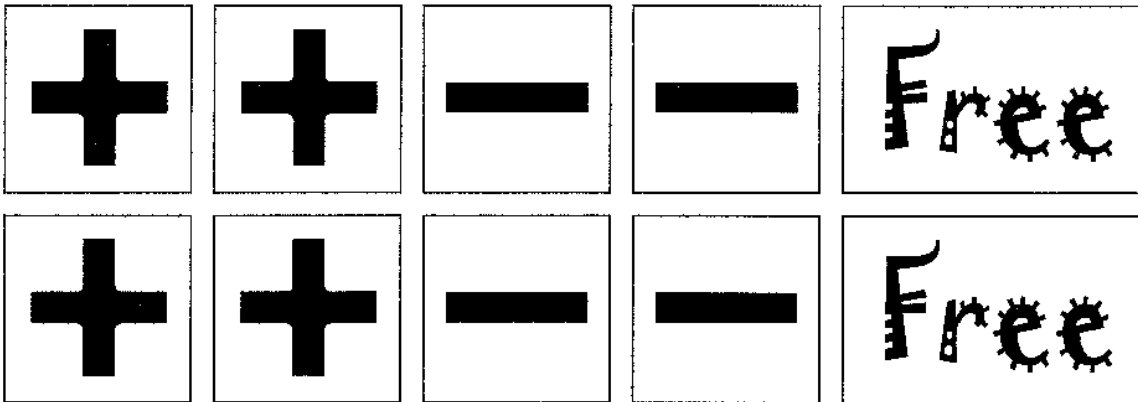
## Roll die #2, 120 times

After each roll, record the number rolled (use tally marks like IIII)

1	2	3	4	5	6
Expect 20	Expect 20	Expect 20	Expect 20	Expect 20	Expect 20
Actual	Actual	Actual	Actual	Actual	Actual

Does either of the dice appear to be biased toward a particular number? If "yes" how can you tell?

# Double Dice Decisions



**GOAL:** The greatest accumulated sum wins

- 1) Roll the double dice
- 2) Decide which operation to use and record the math sentence
- 3) Bank your points and cover up that operation. That operation cannot be used again except as a free choice
- 4) Division sentences must have a remainder of zero in order to score

**EXAMPLE:**

ROLL

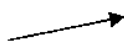
ACCUMULATED POINTS

- 1)  $6 - 2 = 4$
- 2)  $3 + 1 = 3$
- 3)  $4 + 3 = 7$
- 4)  $4 \times 2 = 8$
- 5)  $6 \times 3 = 18$

4  
+3 7  
+7 14  
+8 22  
+18

**40** Total Points

Chooses free



# MYSTERY ROLL

You will need to play either 50 or 100 rounds. Play in groups of 3. Every round record L, E and G plus figure out the RANGE between G and L. Use a calculator if you wish. When you are playing you should use your highlight pen to mark any unusual rolls - for example, tie rolls, sequences, unusual winning rolls, etc. Circle the points you score.

Round #	Least	Between	Greatest	Range	Analyze
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Once you have completed either 50 or 100 rolls  
answer the following questions.

Work Together!

1. What is the average range of the rolls?
2. What percentage of the time does a tie roll happen?
3. What percentage of the time did you score a point? If you kept track of all winners, what percentage of the time did all 3 players score a point?
4. Describe your most unusual round. Try to interpret the probability of that event happening. Remember  $\frac{1}{30}$  chance of rolling any number.
5. Write one question for the rest of the group to use with their data.

# EXCELLENT QUESTIONS FOR DEVELOPING COMMUNICATION IN MATH

Critical Thinking

After Playing The Game

What can you say about...?  
How would you organize?  
What other way would you plan to...?  
How is \_\_\_\_\_ related to \_\_\_\_\_?  
What is the relationship between...?  
Can you invent?  
How would you test?  
Suppose you could \_\_\_\_\_ -- what would you do?

How would you summarize?  
What would result if...?  
What examples can you find to...?  
What conclusions can you draw?  
How would you improve?  
How would you adapt/change or modify?  
Can you predict the outcome if...?

## LET'S TALK ABOUT PROBABILITY

### DICE FACTS

**10-Sided (0-9) Dice** - Great for recognizing numbers, adding to 18, working with doubles, subtracting, graphing, probability, patterns, multiplying, problem-solving.

**10-Sided (0-9) Spotted Dice** - Great for adding to 18, subtracting from 9, and place value work. With spots, students can touch the dots and use as a true manipulative.

**12-Sided (1-12) Dice** - Great for time, months, fractions, adding, subtracting, doubles, graphing, probability, patterns.

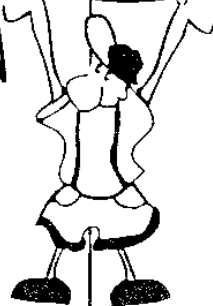
**20-Sided (1-20) Dice** - Great for adding, subtracting, doubles, graphing, probability experiments, estimating and mental math activities.

**30-Sided (1-30) Dice** - Great for adding and subtracting with regrouping, working on larger products, estimation, comparing, probability, calendar, mixed operations.

**6-Sided (0-5) Dice** - Great for recognizing numbers to 6, adding to 12, doubles, subtracting, patterns, multiplying.

**Operation Dice (+, -, x, ÷)** - Great to use with any of the above dice to work on the 4 operations.

**T**here is a direct correlation to the number of sides on a die and kids wanting them. In other words **COUNT YOUR DICE!**



- *Fair Chance, Expected*
- *Best / Worst*
- *Probable / Improbable*
- *Never / Less Likely / Equally Likely*
- *Likely / More Likely / Always*
- *Possible / Impossible / Certain*



# Implementation Plan

List 3 ways you can incorporate the Box Cars strategies into your classroom, program or school.

1.

2.

3.

Identify the game/activity that you will try first, when you get back later this week.

Find a colleague in this room whom you will contact at the end of the week. The two of you will be agreeing to hold a conversation regarding what you did to start implementing what you learned today.

Who:

From:

Phone:

Email:

**You can reach me at:**

[boxcars@telus.net](mailto:boxcars@telus.net)

1 866 DICE FUN (1 866 342 3386)

[www.boxcarsandoneeyedjacks.com](http://www.boxcarsandoneeyedjacks.com)