The Game of PIG

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General Rules:

1. Goal: To score the most points
2. You **MUST** play the first roll of each round.
3. Stand until you stop playing for the round
4. You **MAY** play as many rolls as you like
5. Once you have stopped playing, you are finished for the round. Please sit quietly
6. There are 3 rounds (P-I-G). The person with the highest score at the end of the "G" round wins.

The Game of PIG

Scoring Rules:

1. If a "1" is rolled on the first roll of the round, re-roll.
2. For each round you play, you earn the total of the two dice.
3. When a "1" is rolled, you lose all points for the ROUND.
4. If "Snake Eyes" (double 1s) is rolled, you lose all points for the GAME.

Mathematical Standards practiced within The Game of PIG and its variations.

Standard Number	Grade	Domain	summary
1.OA.A.1	1	Operations and Algebraic Thinking	Addition to 20
1.OA.A.2	1	Operations and Algebraic Thinking	Addition to 20
1.NBT.C.4	1	Numbers and Operations in Base 10	Adding within 100
2.OA.B.2	2	Operations and Algebraic Thinking	Applying properties to operations.
2.NBT.B.5	2	Numbers and Operations in Base 10	Fluently add and subtract within 100
2.NBT.B.6	2	Numbers and Operations in Base 10	Add up to two 2-digit numbers
3.NBT.A.2	3	Numbers and Operations in Base 10	Fluently add and subtract within 1000
3.OA.A.3	3	Operations and Algebraic Thinking	Multiply and divide within 100
3.OA.B.5	3	Operations and Algebraic Thinking	Apply operations of operations as strategies to multiply and divide.
3.OA.C.7	3	Operations and Algebraic Thinking	Fluently multiply and divide within 100
4.NBT.B.4	4	Numbers and Operations in Base 10	Fluently add and subtract multi-digit whole numbers using the standard algorithm.
4.NBT.B.5	4	Numbers and Operations in Base 10	Multiply a whole number up to four
4.MD.B.4	4	Numbers and Operations in Base 10	Display Data

Mathematical Standards practiced within The Game of PIG and its variations.

Standard Number	Grade	Domain	summary
5.NBT.B.5	5	Numbers and Operations in Base 10	Fluently multiply multi-digit whole numbers using the standard algorithm.
5.MD.B.2	5	Measurement and Data	Display data with fractions
6.SP.A.1	6	Statistics and Probability	Recognize statistical variability
6.SP.A.2	6	Statistics and Probability	Understand data distribution
6.SP.B.5	6	Statistics and Probability	Summarize numerical data sets in relation to their context
HSS.MD.A.2	HS	Measurement and Data	Calculate expected value of a random variable
HSS.MD.A.3	HS	Measurement and Data	Develop a probability distribution for a random variable theoretically
HSS.MD.A.4	HS	Measurement and Data	Develop a probability distribution for a random variable experimentally
HSS.MD.B.5	HS	Measurement and Data	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values
HSS.MD.B.7	HS	Measurement and Data	Analyze decisions and strategies using probability concepts.

These math skills are used in making *business* and *advertising* decisions, *sports* decisions, *medical* decisions, *gambling,* and others.

Practice Round:

BLUE	GREEN	TOTAL

Questions to think about (The Math):

1. How likely is it that a 1 will show up?
2. How likely is "Double Ones"?
3. How many points can I expect to earn each round?
4. What strategies will likely be ***"winning"*** strategies?
5. What strategies will likely be ***"losing"*** strategies?

Round P

BLUE	GREEN	TOTAL

Round I:

BLUE	GREEN	TOTAL

Round G:

BLUE	GREEN	TOTAL

Questions to think about (The Math):

1. How likely is it that a 1 will show up?
2. How likely is "***Double Ones***"?

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1

2

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3. How many **points** can I expect to earn each round?
4. What strategies will likely be ***"winning"*** strategies?
5. What strategies will likely be ***"losing"*** strategies?

points	1	2	3	4	5	6
1	0	0	0	0	0	0
2	0	4	5	6	7	8
3	0	5	6	7	8	9
4	0	6	7	8	9	10
5	0	7	8	9	10	11
6	0	8	9	10	11	12
TOTAL	0	30	35	40	45	50

SUM = 30 + 35 + 40 + 45 + 50

SUM = 200; there are 25 non-zero rolls

Average = 200/25 = 8

The expected total per roll without a zero is 8 points

The probability of a roll with 0 total points is 11/36 (a little less than 1/3)

The expected total per roll without a zero is 8 points.
The expected total per roll, if you include zeros is $5\frac{5}{9}$

The probability of a roll that results in 0 total points is 11/36 (a little less than 1/3)

Knowing this about the mathematics of the Game of Pig, what *strategies* can you make that might help you win the game?

example: ***Play until a 1 shows up*** (an actual strategy proposed by a student)...

How successful would you expect this strategy to be? Why?

Other possible strategies:

- Strategy doesn't matter. The game is all luck.
- Strategy does matter.

Common strategies:

- Roll up to a specific value and then stop.
- Roll a certain number of times and then stop.
- Roll until your total will beat your opponents' and then stop.

How can you "test" a variety of strategies to determine which is best?

The Game of Pig - Essential Questions

• Do you have a strategy? What is it?

• How do you know your strategy works? How could you test it?

• Does strategy matter?

• If it does, what is the best strategy?

• If you don't think strategy matters, why not?

• What happens when you play your strategy against another student's different strategy?

• Between these two strategies (name two collected from the class), who do you think will win?

Mathematical Questions to Explore:

1) How likely is it that a round will extend beyond 3 rolls? 4 rolls? 10 rolls? etc.

2) How likely is it that you can earn 20 points or more in a round?

3) Is it possible to roll a 1 more than once every 6 times?

4) others?

Variations

Big PIG

This variation is played with two dice. It is like PIG: on your turn you can roll or hold. If you roll a 1, you lose your points for that turn and your turn ends. However, you roll a pair of 1s, add 25 to your turn total. If other doubles are rolled, the player adds twice the value of the dice to the turn total. Play to 150.

Odd PIG Out

Roll two dice and *multiply* them. You can keep rolling as long as the product is even. If the product is odd, you lose all unbanked points for that turn, and pass the dice. Play to 500.

SKUNK

SKUNK is played exactly like PIG, except that it has 5 rounds instead of 3.

Variations

Game of PIG - Sixes: A game for two players, using two dice. The winner is the first player to get 100 or more points.

You both start with zero points and take turns to throw the dice as many times as you like adding the total at each throw to your score.

Throwing one 6 ends the turn and nothing is added to the score for that turn.

Throwing a double 6 ends the turn and the total score goes back to zero.

Imagine we change the rules of the game. How would your strategy be affected?

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A one-die version: Roll just one die. If you roll a six, your turn ends and your total reverts to what it was at the start of your turn.

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A friendlier version: double sixes (or double ones for the original game) don't reset your total score to zero, but one or two sixes still ends your turn.

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Backwards PIG:

Start at 100, but subtract with each roll. The winner is the first to zero. A one reverts your score to the beginning of the round. Double ones resets your score to 100. The rest of the rules remain intact.