



*Drexel-SDP GK-12 ACTIVITY*

## Activity: RPS - Dependent Events

**Subject Area(s)** Data Analysis & Probability

**Associated Unit** Rock, Paper, Probability

**Associated Lesson**

**Activity Title** RPS - Dependent Events



**Dependent Rock, Paper, Scissors: worse than a coin, better than an 8-ball.**

**Grade Level** 7 (6-10)

**Activity Dependency**

RPS - Independent Events

**Time Required** 40 minutes

**Group Size** Variable

**Expendable Cost per Group** US\$0

**Summary**

Students play matchups and rounds of rock, paper, scissors (RPS) along a tournament bracket format and then answer questions that cover probability and/or current course topics.

## Engineering Connection

In comparative studies, particularly those in the biomedical field, statistics are used to compare data sets and determine the effectiveness of treatments by calculating each treatment's chance of occurring, known as probability. Experimental and theoretical probability are central concepts to the engineering field, since physical phenomena do not always follow the mathematical descriptions of behavior, known as *mathematical models*, because they are typically derived from idealized assumptions.

## Keywords

rock, paper, scissors, probability, bracket, tournament, independent event, fair game, theoretical probability, experimental probability

## Educational Standards

- PA Math:
  - 2.7.3.A. Predict and measure the likelihood of events and recognize that the results of an experiment may not match predicted outcomes.
  - 2.7.5.A. Perform simulations with concrete devices (e.g., dice, spinner) to predict the chance of an event occurring.
  - 2.7.5.B. Determine the fairness of the design of a spinner.
  - 2.7.5.C. Express probabilities as fractions and decimals.
  - 2.7.5.D. Compare predictions based on theoretical probability and experimental results.
  - 2.7.5.E. Calculate the probability of a simple event.

## Pre-Requisite Knowledge

Students must know how to follow a tournament bracket and play rock, paper, scissors. This activity is intended to be used after “RPS - Independent Events.”

## Learning Objectives

After this activity, students should be able to:

- Show progression of dependent events on a tree diagram
- Determine if a game is “fair” based on expected outcomes
- Predict path-dependent events
- Compute probability of path-dependent events

## Materials List

Each group needs:

- RPS Tournament Worksheet

To share with the entire class:

- 1 deck of playing cards (poker deck)

## Introduction / Motivation

We’re going to put a spin on our last activity involving the game Rock, Paper, Scissors. Can someone explain what we did last time? (Play RPS and note wins, losses, and ties in order to compare experimental probability to theoretical probability for a best-of-five game series). Last time what was the probability of winning a single game? ( $1/3$ , since there are equally likely chances of winning, losing and tying for each player). What if I told you that we are going to

play again, but this time you could not play the same thing twice (including ties)? Do you think that this rule would affect your chances of winning?

This is an example of dependent events. A dependent event is based on another event. Can you give an example of a dependent event? (Not cleaning room, getting in trouble; kissing a girl, getting slapped; etc.). If we want to expand the casino game analogy, we'd be considering poker and blackjack – games in which serious players consider the likelihood of certain cards being dealt based on other cards in play. For RPS, if you start a matchup with our new rule and choose to “throw” a rock the first game, in the next game you could “throw” paper or scissors. The choices you are left with in the second game are dependent on what you did in the first game.

Test questions usually base the dependency of events on someone picking marbles out of a jar. If they replace the marble before taking another, that indicates independent events. Why? (Because the number of marbles in the jar returns to the original amount). If the question indicates that the marble is not replaced, then the number of marbles in the jar changes each time a marble is chosen, and that changes the probability of choosing a certain marble. This is indicative of a dependent event.

We are not going to play the full tournament bracket, but it is on your handouts as a matchup guide. Play the first round until someone wins 2 games and keep track of the outcomes in games you play (if you have a “2,” then play against another two with the same color). Note a win, loss, or tie with “W,” “L,” or “T,” respectively, and note what you played with an “R,” “P,” or “S.” Use the data table provided on the worksheet.

### Vocabulary / Definitions

Word	Definition
Experimental probability	The expected chance of an outcome. Defined as $P_{\text{exp}} = \frac{\text{Actual Outcome}}{\text{Number of Expected Outcomes}}$
Theoretical probability	The observed chance of an outcome. Defined as $P_{\text{theor}} = \frac{\text{Expected Outcome}}{\text{Number of Expected Outcomes}}$
“fair” game	A game in which winning and losing have equal theoretical probabilities.
Independent event	An event whose outcome is not affected by another event, i.e. a player winning two matchups of RPS while having the ability to throw a rock, paper, or scissors each time.
Dependent event	An event whose outcome is influenced by another event, i.e. a player winning two matchups of RPS if, in the second matchup they cannot throw the object that they used in the first matchup.

### Procedure

#### Background

The worksheet linked to this activity includes a bracket that accommodates 28 students. For classes with less than 28 students, remove the 2's before any other face value. The bracket is “seeded” as students draw playing cards with face values ranging from 2 through 8. Bracket “divisions” corresponding to the suits: hearts, diamonds, clubs, and spades, can be arranged in different areas of the classroom.



**Rock beats scissors.**

### **Before the Activity**

- Distribute worksheet packet
- “Seed” the bracket by allowing students to choose playing cards

### **With the Students**

1. Establish a hypothesis about whether the new rule (no repeats) shifts the odds of winning.
2. Assist with keeping the order of the brackets once the “divisions” are decided.
3. Observe the students keeping track of wins, losses, *and ties* on their bracket by recording a “W,” “L,” or “T” for each matchup, as well as the symbol they used (“R,” “P,” or “S”).

### **Attachments**

rock\_paper\_probability\_1\_activity\_rps-independent\_events\_worksheet.pdf

### **Assessment**

The goal of the worksheet is to show the path-dependency of outcomes and exponentially increasing number of subsequent events. Only one-third of the events (through 3 games) are shown; similar diagrams could be constructed if initially playing Paper or Scissors.

After giving examples, students should be encouraged to complete the tree diagram and find the probability of the indicated events occurring. If students have trouble grasping the point of the activity, review the answers frequently.

Point out that the probability of *not losing* consecutive games is higher than *winning* consecutive games. When playing RPS with a no-repeat rule, a “tie” can be used as a defense.

### **References**

Probability Activities < <http://www.math.wichita.edu/history/activities/prob-act.html#prob1>>

### **Other**

Bracket Generator <<http://www.crowdarts.com/brackets/tourn.html>>

### **Owner**

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