

**Pennsylvania Governor's Institute  
for Mathematics Educators  
2004**

**Names of Group Members:** Tammy Grimes, Mary Johnson, Sandy Madden, Matt Mugmon, Nancy Sherlock-Robson

**Topic/Theme:** Experimental and Theoretical Probability

**Level:** Grades 6 - 8

**Time Element:** 2 class periods of 45 minutes

**NCTM Standards Addressed:**

**Number and Operations**

- work flexibly with fractions, decimals, and percents to solve problems
- understand the meaning and effects of arithmetic operations with fractions, decimals, and integers

**Data Analysis and Probability**

- formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population
- select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots

**Problem Solving**

- build new mathematical knowledge through problem solving
- solve problems that arise in mathematics and in other contexts
- apply and adapt a variety of appropriate strategies to solve problems
- monitor and reflect on the process of mathematical problem solving

**Communication**

- organize and consolidate their mathematical thinking through communication
- communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- analyze and evaluate the mathematical thinking and strategies of others

**Connections**

- recognize and use connections among mathematical ideas
- understand how mathematical ideas interconnect and build on one another to produce a coherent whole

**Representation**

- create and use representations to organize, record, and communicate mathematical ideas
- use representations to model and interpret physical, social, and mathematical phenomena

**PA Math Standards Addressed:**

**2.7.8 Probability and Predictions**

- A. Determine the number of permutations for an event.
- B. Present the results of an experiment using visual representations (e.g., tables, charts, graphs).
- C. Analyze predictions (e.g., election polls).
- D. Compare and contrast results from observations and mathematical models.
- E. Make valid inferences, predictions and arguments based on probability.

**2.6.8 Statistics and Data Analysis**

- A. Design and carry out a random sampling procedure.

**2.1.8 Numbers, Number Systems and Number Relationships**

- A. Represent and use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, exponents, scientific notation, square roots)

**2.2.8 Computation and Estimation**

- B. Add, subtract, multiply and divide different kinds and forms of rational numbers including integers, decimal fractions, percents and proper and improper fractions

**2.5.8 Mathematical Problem Solving and Communication**

- A. Invent, select, use and justify the appropriate methods, materials and strategies to solve problems.
- B. Verify and interpret results using precise mathematical language, notation and representations, including numerical tables and equations, simple algebraic equations and formulas, charts, graphs and diagrams.
- C. Justify strategies and defend approaches used and conclusions reached.

**Math Assessment Anchors Addressed:**

- M6.E.3.1** Determine all possible combinations, outcomes and/or calculate the probability of a simple event.
- M7.E.3.1** Determine theoretical or experimental probability.
- M7.E.4.1** Draw conclusions and/or make predictions based on data displays.
- M8.E.3.1** Calculate the probability of an event.
- M8.E.3.2** Determine the number of combinations and/or permutations for an event.

**Reading Assessment Anchors Addressed:**

- R6.A.2.1** Identify the meaning of vocabulary from various subject areas.

**Objectives:**

- Determine all possible outcomes of an experiment.
- Calculate theoretical probability.
- Compare and contrast theoretical and experimental probability.
- Utilize an appropriate method of recording data.

**Areas of Prior Knowledge:**

Students should be able to:

- Record data in an organized format
  - Frequency Table
  - Tally Chart
  - Table
- Convert their experimental results into a fraction form
- Convert fractions into decimals
- Add together a series of numbers (whole, decimal or fraction)

**Instructional Strategies and Plan (include strategies used to help different types of learners, i.e. auditory, visual, etc.):****Day 1: Experimental Probability**

- In pairs, each student will toss one die for a total of 50 events. Each pair will record the sum of the two dice using a recording method they determine (see attached activity sheet).
- Each pair will then combine with another pair and record their pooled results in the groups of 4. These groups then record their results on the overhead to create a combined class total number of occurrences for each possible outcome.
- Using calculators, each group will determine the experimental probability as fractions and decimals.
- Guided discussion to show that the sums of those fractions (or decimals) will be 1.
- Closing: “Ticket out” question about what outcomes seem most likely (See attached assessment sheet).

*\*Employing the strategy of pairing students allows students with disabilities to be assisted by their partners.*

**Day 2: Theoretical Probability**

- Starting in groups of 4 from the previous day, students complete the grid of possible outcomes for the experiment (see attached activity sheet).
- Instruction/Inquiry:
  - What outcome is most likely and why?
  - Definition of probability including the fact that total probability always equals 1
  - Comparing and contrasting experimental probability from Day 1 (the class total) with the theoretical probabilities in Day 2.

### **Materials/Resources:**

1 die per student, 1 graphing calculator per 2 students, 1 copy of each of the two student worksheets per student, 1 copy of the assessment per student, overhead projector, (optional: overhead graphing calculator)

### **Interdisciplinary Connections:**

#### **Reading**

- Introduce the book Do You Wanna Bet ? Your Chance To Find Out About Probability.( Jean Cushman)
- Teachers can use the Internet for ideas, lesson plans and other information to support the use of this book in their classroom.

#### **Technology**

- A Graphing Calculator to randomly generate numbers (See Extensions.)
- A spreadsheet program to organize the results from the randomly generated event

### **Assessment Strategies:**

- **Formative Evaluation (checking student understanding during the lesson):**
  - Informal checks via teacher circulation throughout class as well as questioning during summary. In this way, the teacher will know that the student can gather and record experimental probability outcomes and represent the results (two of the lesson's objectives).
  - "Ticket out" journal entry as closing for Day 1 to assess understanding of possible outcomes and which outcomes seem most likely. (See attached.)
- **Summative Evaluation (how will it be determined that the objectives were achieved?):**
  - At the end of Day 2, a short quiz of seven questions will assess understanding of objectives to determine all possible outcomes, to calculate theoretical probability, and to compare and contrast theoretical and experimental probability.

### **Correctives/Remediation:**

- Small group instruction – similar activity with fewer possible outcomes (i.e., coin toss with two possible outcomes; one die with six possible outcomes) to reintroduce concept of probability.
- Paired instruction – modeling formation of fractions and/or conversion of fractions to decimals and/or addition of decimals.
- Tree Diagramming to model 36 possible outcomes of toss of two dice.

**Extensions/Enrichment:**

- Organize Day 1 results on a spreadsheet.
- Use the graphing calculator to generate numbers between 2 and 12. Hypothesize why the results are different from the Dice Game.
- Explore alternate methods of representing data.

**Special Accommodations (special needs students)****• Description of the Special Needs Student Selected:**

Case 3: Thomas receives Emotional Support (ES) Services in a part time Learning and Emotional Support classroom. His IEP includes annual goals to develop reading skills to build reading fluency and comprehension, to develop math skills in the four basic processes (he is two grade levels behind in the district math curriculum) and to improve social skills by acquiring conversational skills, recognizing and expressing feelings and solving problems in conflict situations. Through an informal Functional Behavior Assessment (FBA), the team has ascertained that Thomas engages in noncompliant behaviors such as arguing, talking out and destruction of learning materials as a means to escape completing his assigned school work, especially in his regular (inclusion) classes. Incidences of these challenging behaviors occur at least three times a week in his regular math class, although his teacher reports that it appears he is motivated to be in the class (Thomas will ask her for help when other children are not present).

**• Accommodations to Use with this Student:**

- Pre-conference to prepare Thomas for the structure of the activity.
- Create advance organizers that segregate the expected tasks and present the instructions step-by-step. Discuss and read through with the student in the pre-conference.
- Recommend that either the classroom teacher or special ed resource teacher review the mathematical concepts of basic understanding of fractions, fraction/decimal conversion and organized recording of data prior to class.
- Allow him the option *initially* to either work individually or with a partner (with the understanding that he will ultimately be expected to combine his results with a small group of students to create a class summary).
- Provide a calculator for his use in all phases of the activity.
- If available, ES teacher or aide could accompany student.