

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

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**Topic/Theme:** Exploring experimental and theoretical probability of male/female puppy combinations.

**Level:** 6<sup>th</sup> grade

**Time Element:** This should take 5 class periods 40 minutes in length.

**NCTM Standards Addressed:**

**Number and Operations Standard for Grades 6–8**

**Expectations**

<b>Instructional programs from prekindergarten through grade 12 should enable all students to—</b>	<b>In grades 6–8 all students should—</b>
Understand numbers, ways of representing numbers, relationships among numbers, and number systems	<ul style="list-style-type: none"> <li>• work flexibly with fractions, decimals, and percents to solve problems;</li> <li>• compare and order fractions, decimals, and percents efficiently and find their approximate locations on a number line;</li> <li>• understand and use ratios and proportions to represent quantitative relationships;</li> </ul>
Understand meanings of operations and how they relate to one another	<ul style="list-style-type: none"> <li>• understand the meaning and effects of arithmetic operations with fractions, decimals, and integers;</li> </ul>
Compute fluently and make reasonable estimates	<ul style="list-style-type: none"> <li>• select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods;</li> </ul>

## Data Analysis and Probability Standard for Grades 6–8

### Expectations

Instructional programs from prekindergarten through grade 12 should enable all students to—	In grades 6–8 all students should—
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	<ul style="list-style-type: none"><li>• select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots.</li></ul>
Understand and apply basic concepts of probability	<ul style="list-style-type: none"><li>• use proportionality and a basic understanding of probability to make and test conjectures about the results of experiments and simulations;</li><li>• compute probabilities for simple compound events, using such methods as organized lists, tree diagrams, and area models.</li></ul>

## Problem Solving Standard for Grades 6–8

**Instructional programs from prekindergarten through grade 12 should enable all students to—**

- 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 Standard for Grades 6–8

**Instructional programs from prekindergarten through grade 12 should enable all students to—**

- 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;
- use the language of mathematics to express mathematical ideas precisely.

## Connections Standard for Grades 6–8

Instructional programs from prekindergarten through grade 12 should enable all students to—

- recognize and apply mathematics in contexts outside of mathematics.

## Representation Standard for Grades 6–8

Instructional programs from prekindergarten through grade 12 should enable all students to—

- create and use representations to organize, record, and communicate mathematical ideas;
- select, apply, and translate among mathematical representations to solve problems;

## PA Math Standards Addressed:

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

**2.4.8.F** Use measurements and statistics to quantify issues (e.g., in family, consumer science situations).

**2.5.8.A** Invent, select, use and justify the appropriate methods, materials and strategies to solve problems

**2.5.8.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.

**2.5.8.C** Justify strategies and defend approaches used and conclusions reached.

**2.5.8.D** Determine pertinent information in problem situations and whether any further information is needed for solution.

**2.6.8.E** Analyze and display data in stem-and-leaf and box-and-whisker plots.

**2.6.8.F** Design and carry out a random sampling procedure.

**2.6.8.D** Determine the number of combinations and permutations for an event.

**2.7.8.A** Present the results of an experiment using visual representations (e.g., tables, charts, graphs).

**2.7.8.B** Analyze predictions (e.g., election polls).

**2.7.8.C** Compare and contrast results from observations and mathematical models.

**2.7.8.D** Make valid inferences, predictions and arguments based on probability.

**2.7.8.E** Use scientific and graphing calculators and computer spreadsheets to organize and analyze data.

**Math Assessment Anchors Addressed:**

**M6.E.1.1** Interpret data shown in frequency tables, histograms, circle graphs, bar or double bar graphs, line or double line graphs or line plots.

**M6.E.3.1** Determine all possible combinations, outcomes and/or calculate the probability of a simple event.

**M6.A.1.3** Use or develop models to represent percents.

**M6.A.3.2** Solve problems with and without the use of a calculator.

**Reading Assessment Anchors Addressed:**

**R6.A.1.3** Make inferences and draw conclusions based on text.

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

**R6.A.2.6** Check the validity and accuracy of information obtained from reading by differentiating fact from opinion.

**R6.A.2.7** Analyze text organization including sequence, comparison/contrast, cause & effect, problem/solution, the headings, graphics and charts to derive meaning.

**Objectives:** Students will be able to:

- Use the counting principle.
- Make and use organized lists.
- Calculate theoretical probability.
- Calculate experimental probability.
- Create a bar graph to represent calculated results.
- Use manipulatives to simulate a problem.
- Demonstrate appropriate participation within a group.

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

**Day One**

Teacher will introduce the counting principle using simple examples involving experimentation.

Students will then be introduced to the puppy prediction project. They will use the counting principle to determine the number of possible permutations.

Using an overhead projector, the teacher and students will work together to create an organized list of the permutations.

**Day Two**

The teacher will distribute copies of the organized list generated in the previous class period. Students will use highlighters or colored pencils to categorize results.

Students will then work within groups to calculate percentages for each combination.

**Day Three**

Students will be working in groups of four. Each student will be given six pennies. Each will toss his/her group of pennies. Heads will represent male puppies and tails will represent female puppies. Students will record the results on the Experimental Probability worksheet in order to simulate the litter outcomes. Each student will perform twenty-five trials.

Students will then categorize and color code results as they did on the Theoretical Probability worksheet.

**Day Four**

Each student will calculate percentages of probability based on their penny toss results. These percentages will be recorded on the Experimental Probability worksheet. After all four are completed students will find an average for each set. Students can then compare their theoretical and experimental percentages.

**Day Five**

Each group will use graph paper to create a bar graph representing the comparison of both Theoretical and Experimental Probabilities found. A representative from each group will briefly share the group's poster and findings with the rest of the class.

### **Materials/Resources:**

- 6 Pennies per student
- Pencils
- Markers
- Rulers
- Paper
- Highlighters or colored pencils
- Graph paper
- Overhead projector
- Overhead transparency of organized list (empty)
- Overhead markers
- Organized List worksheet (empty)
- Organized List worksheet (completed)
- Theoretical Probability worksheet
- Experimental Data worksheet
- Experimental Probability worksheet

### **Interdisciplinary Connections:**

- **Reading** – Students could read a book involving twins, triplets, or other multiple births.
- **Technology** – Teacher will use overhead projector to demonstrate creating an organized list.
- **Other** – Language Arts class:
  - Students could write a story about one of the puppies and its future.
  - Students could research two different breeds of dogs and compare and contrast size of puppies at birth.

### **Assessment Strategies:**

- **Formative Evaluation (checking student understanding during the lesson):**
  - Teacher will observe cooperative groups for student understanding and participation.
  - Teacher will help and guide groups, and conduct discussion on group progress.
- **Summative Evaluation (how will it be determined that the objectives were achieved?)**

### **Correctives/Remediation:**

Teacher will guide instruction by using lead questions as each group is monitored. Teacher will assign peer tutoring or reteach specific areas for greater understanding.

### **Extensions/Enrichment:**

- Students will use computers and/or calculators to graph outcomes.

### **Special Accommodations (special needs students)**

- **Description of the Special Needs Student Selected:**

“Emily” has a severe hearing loss in both ears. Her language comprehension and expressive skills are 4 years below grade level, as are her reading skills. She is above grade level in basic math computation, but has great difficulty with word problems and abstract concepts. “Emily” uses an assistive listening device in the classroom to allow her to hear better, but even with that she has difficulty comprehending lengthy verbal explanations. She does not use sign language. She learns best with using visual representation of information or a process when possible.

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

- Worksheets will be clear of clutter and have easily identified places for answers.
- Use Assistive Listening Device during small group time to enhance understanding of members voices.
- Tell group members to speak one at a time in order to include Emily’s participation.
- Demonstrate (model) all instructions.
- Provide Emily with a buddy to check if directions are understood.
- Teacher will abbreviate instructions to include basic facts necessary to complete project.
- Emily will be seated close to the front of the room to better see teacher’s mouth.