Mission Science: Probability and Scientific Process Lesson

| **Subject***:* Mathematics, STEM Education  **Related Subjects:** Science | **Grade Level(s):** 6-8  **Length of Lesson:** 60 minutes | **Type:** Design  **Keywords:** Probability, Data Collection, Histogram, Experiment |
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# Lesson Overview

Probability allows us to make educated predictions of the outcome of an event.

Designing experiments allows us to test our predictions and use real world experiences to support theoretical ideas. Taking more data provides more trustworthy results. Also the way we present our data can affect the way others understand it – some ways of presenting data are better than others.

# Lesson Focus

How does experimental data compare with predicted probability? Can we use experiments to test if real-world results align with mathematical predictions?

| Lesson Objective(s) | * Understand basic probability as the fraction of favorable outcomes over possible outcomes. * Design an experiment based on a prediction. * Record data using tally marks. * Analyze data and present findings in a histogram. * Compare theoretical probability with experimental outcomes. |
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# Lesson Timing

| 5 minutes | Introduction to probability and lesson goals |
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| 10 minutes | Mini-lesson with examples of probability using cards, dice, and coins |
| 20 minutes | Student experiment: hypothesis, data collection, tally marks |
| 10 minutes | Graphing results using histograms |
| 15 minutes | Discussion, data comparison, and wrap-up |

| Materials | * Deck of cardsMacintosh HD:Applications:Microsoft Office 2011:Office:Media:Clipart: Business.localized:skd188779sdc.pngMacintosh HD:Applications:Microsoft Office 2011:Office:Media:Clipart: Business.localized:skd186475sdc.png * Dice * Coins * Blank experiment handouts |
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| Instructor Prep | 1. Review and prepare brief examples to explain probability (e.g., coin flip = 1/2 or 50%) 2. Copy experiment handouts 3. Pre-sort materials into small group kits (cards, dice, coins) |
| Related Resources | * [Probability with Dice | PBS LearningMedia](https://ca.pbslearningmedia.org/resource/mgbh.math.sp.probabilitydi/probability-with-dice/) * [Statistics and probability | Math | Khan Academy](https://www.khanacademy.org/math/statistics-probability/probability-library) |

# Lesson Plan

## Introduction

1. Introduce the idea of **mathematical probability** vs. **experimental results**.
2. Discuss real-world examples (e.g., weather forecasts, sports statistics, or medical testing).
3. Pose the question: *"Do outcomes always match the prediction?"*
4. Connect to STEM careers (e.g., data analysts, engineers, epidemiologists).

## Procedure

1. After a quick lesson about probability, kids will be given materials to test the concepts they just learned.
2. The students will write the purpose – “Compare the mathematical probability of an event to the experimental data”
   1. Event is up to them - Cards ex. Red or black, Suit, face card vs. number, odd or even, etc
3. The students will make a mathematical prediction – ex. 50% chance of drawing a red card.
4. The students will roll dice, draw cards, or flip coins and record the outcome in a chart using tally marks. They should record the probability after 5,10, and 20 rolls, draws, etc.
5. They will then fill in a histogram with the number of outcomes of each event.

## Wrap-up

* Share our results
* Follow up questions:
  + Were your results close to your prediction?
  + Better results after 5, 10, or 20 rolls, flips, etc.?
  + Was it easier to understand results in graphs or tables?
  + What are other ways you could experiment with probability?

# Lesson Background for Teachers

**Concept Review:**

Probability is used in many fields—from predicting traffic patterns to evaluating risks in finance and medicine. The Law of Large Numbers shows that with more trials, experimental probability tends to get closer to theoretical probability.

Related Real-World Problems:

* Forecasting weather or natural disasters.
* Quality control in manufacturing (defect rates).
* Clinical trials and drug testing.

## Lesson Variations and Options

* Use digital tools like Google Sheets or Desmos to create histograms.
* Integrate real data sets (e.g., sports stats or survey results).
* Add a challenge: Calculate cumulative probability or run two events simultaneously (compound probability).

## Explanation

**Key Concepts:**

* **Probability:** Likelihood that a particular event will occur, expressed as a fraction or percentage.
* **Tally Marks:** Simple way to record frequencies during trials.
* **Histogram:** A type of bar graph showing how often different outcomes occur.

## Key Concepts and Vocabulary

* **Probability:** The chance of something happening.
* **Outcome:** A possible result of an experiment.
* **Experiment:** A test done to find out what happens.
* **Histogram:** A graph that uses bars to show how often something happens.