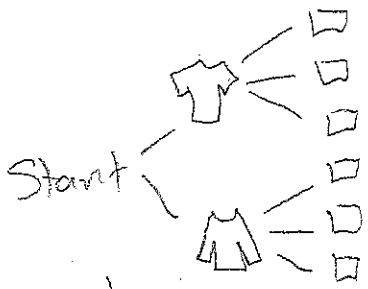
Probability

Models

Tree Diagram

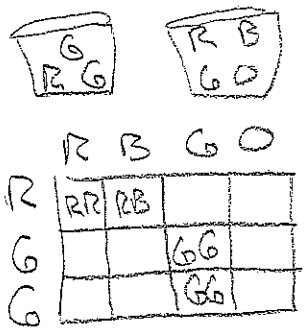
• 2 shirts • 3 colors
* possible combinations



Question
What is the probability of a red, long sleeve shirt?

$\frac{1}{6}$ ← result
6 ← possible results

Area Model



Question
What is the probability of choosing GG?

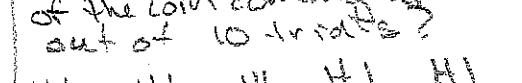
$\frac{1}{6} = \frac{2}{12}$ ← 2 results
← possible results

Types of Probability

Experimental

$\frac{\#\text{ of times the event occurs}}{\text{total \# of trials}}$

example: actually tossing a coin a certain # of times
Question: What is the prob. of the coin coming up heads out of 10 trials?



$\frac{10}{10}$ $\frac{10}{10}$ $\frac{10}{10}$ $\frac{10}{10}$ $\frac{10}{10}$

Type of ratio → Relationship
# of heads out of total trials

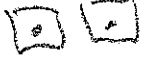
Theoretical

the # of ways a result can happen
the # of possible results

example: tossing a coin in theory
1 way (either H or T)
2 possible results (H or T)

$\frac{1}{2} = 50\% = 0.50$

Rules of Probability

Rule	Event	Definition	Application	Mathematical Representation
addition	mutually exclusive	when events cannot occur simultaneously	 What is the prob. of the spinner landing on yellow or 3? P(yellow or 3) = P(yellow) + P(3) $\frac{1}{2} = \frac{3}{6} = \frac{2}{6} + \frac{1}{6}$	P(A or B) = P(A) + P(B) (A, B: events; P: probability)
multiplication	independent	One event doesn't affect the prob. of the other event	Rolling Dice: What is the prob. of rolling two ones?  P(one and one) = P(one) • P(one) $\frac{1}{36} = \frac{1}{6} \cdot \frac{1}{6}$	P(A and B) = P(A) · P(B)

STANDARDS

- We will use experimental and theoretical probability to solve real-world problems.
- We will understand that the probability of mutually exclusive events occurring is the sum of their probabilities and the probability of independent events occurring is the product of their probabilities.

Inquiry

- Design & use an appropriate simulation to estimate the probability of real-world events
- Explain & calculate the relationship probability and odds of desired outcome — experim
- Use experimental + theoretical probability to make predictions about real-world events
- Use probability to generate convincing arguements, draw conclusions, & make decisions.
- Understand that the probability of 2 unrelated events occuring is the sum + that the prob. of of one event following another is the product of 2 probabilities

UNIT PLANNING TOOL

Unit ______: Probability

Unit Goals:

understand experimental + theoretical probabilities, odds against/for, related events, consecutive

Standards:

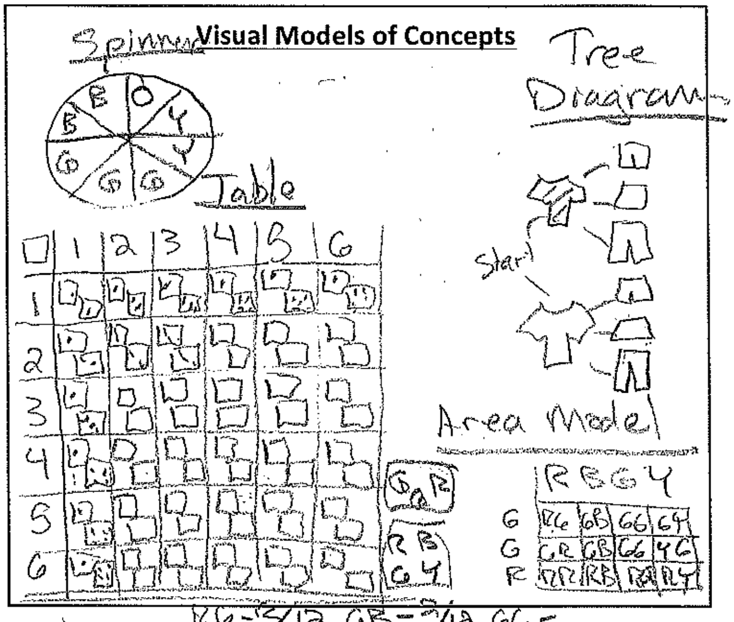
Vocabulary

mutually exclusive
compound events
probability
ratio
inclusive events
independent } events
dependent } events
expected value
outcome
predictions
simulation
experimental prob.
theoretical prob.
binomial Outcomes
compound event
area model

Key Concepts

- Identify outcomes and make predictions
- use experimental + theoretical probability with real-world events
- understand probability w/ related and unrelated events
- the larger the amount of trials the more closely experimental probability approximates the theoretical probability

Visual Models of Concepts



Algorithms/Diagrams

favorable outcomes / Possible outcomes

mutually exclusive event

addition rule: $P(A \text{ or } B) = P(A) + P(B)$

inclusive event (obtaining either)

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

independent events

$P(A) \cdot P(B) = P(A \text{ and } B)$

dependent events – one effects the other

event① event②

$P(A) \cdot P(B/A) = P(A \text{ and } B)$

Connections (Real World Applications)

$40K
$35K
- Bioinformatics – sequencing of genomes (DNA) $50K – $87K in 10
- Insurance (actuaries) $48K – $88K $114K (10-19) → $143K (20)
- Environmental Statistics $86K $142K
- Operations Research $30K – $99K
- Survey Research
- meterologist

Language Functions/Structures

Explain
The probability of ___ and ___ have a sum of ___ because ______

Analyze
If ______ happens first and then ______ happens, the product will be ______ because ______.

CCSSM

probability (starts in 6th) w/statistics

6th

- Develop understanding of statistical variability
- Summarize & describe distributions

7th

- use random sampling to draw inferences about a population
- Draw informal comparative inferences about two population
- Investigate chance processes & develop, use, & evaluate probability models

8th

- investigate patterns of association in bivariate data

Focus & Motivation

Brainpop – basic probability
→ Compound Events

Study Jams – Identify Outcomes & make predictions
– find Probability
- combinations
- Tree Diagrams

Literature
"Probably Pistachio" by Stuart Murphy

"A Very Improbable Story: A Math Adventure" by Ethan Einhorn

"It's Probably Penny" by Loreen Leedy

"No fair!" by Caren Holtzman

"The I Hate Mathematics! Book" by Marilyn Burns

NM Math

K-4 Understand & apply basic concepts of probability

5-8 → same

CCSSM

6 - start of statistics & probability

NM HS

9th - 12th

- explain the concept of a random variable
- explain how the relative frequency of a specified outcome of an event can be used to estimate the prob of the outcome
- use the results of simulations to compute the expected value & prob of random variables in simple cases
- compute the prob of an event using the complement rule, addition rule for disjoint & joint events, multiplication rule for independent events, and rules for conditional prob

Data Analysis & Probability

CCSSM

K-5 Measurement & Data

Shift (Domains)

K

- Counting & cardinality

1-5 → 6-8

- Operations & Algebraic Thinking
- Numbers & Operations in base 10
- Numbers & Operations ~~&~~ Fractions
- Measurement & Data
- Geometry

6-8

- Ratios & Proportional Relationships
- Number System
- Expressions & Equations
- Geometry
- Statistics & Probability

HS

- Number & Quantity
- Algebra
- Functions
- Modeling
- Geometry & Probability

NMSS

6th

- list all possible outcomes for a compound event composed of 2 independent events & recognize whether an outcome is certain, impossible, likely, or unlikely
- determine & compare experimental (empirical) and mathematical (theoretical) prob. determine when & exper. prob. & use them to make predictions about events
- represent all possible outcomes for comp. events in an org. way (tables, grid paper, tree diagrams) & express theoretical probs of each outcome
- use data to estimate the prob. of future events
- represent prob. as ratios, proportions, decimals b/tw 0 & 1, % b/tw 0 & 100 and verify that the prob. computed are reasonable
- know that 1-P is the prob of an event & 1-P is the prob. of the event not occurring
- describe the diff. b/tw indep & depend events & identify situations involving independent events

7th

- determine the probability of a compound event of 2 independent events
- identify examples of events having the prob. of zero
- determine the prob. of events using fractions, decimals, & %
- express prob. as a fraction, zero, or one
- use prob to generate convincing arguments, draw conclusions, & make decisions in a variety of situations
- Make predictions on theoretical prob of compound events
- Determine the prob of a simple event or a comp event composed of a simple, independent events.

8th

- Calculate the odds of a desired outcome in a simple experiment
- Design & use an approp. simulation to estimate the prob of a real-world event (disk toss, cube toss)
- explain the relationship b/tw prob & odds & calculate the odds of a desired outcome in a simple experiment.
- use theoretical or exper. prob to make predictions about real-world events
- use prob to generate convincing arguments, draw conclusions, & make decisions in a variety of situations
- Understand that the prob of 2 unrelated events occurring is the sum of the ind prob. & that the prob of one event following another, in indep trials, is the product of the 2 probs.

HS

Statistics & Probability

- Conditional Probability & the rules of Probability
  - understand independence & conditional probability & use them to interpret data
  - use the rules of probability to compute probabilities of compound events in a uniform probability model
- using probability to make decisions
  - calculate expected values & use them to solve problems
  - use probability to evaluate outcomes of decisions

Probability

the chance something will occur

Models

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·2 shirts ·3 colors

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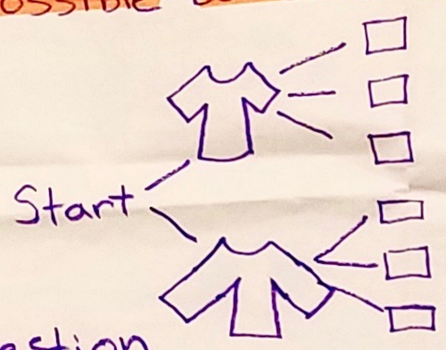

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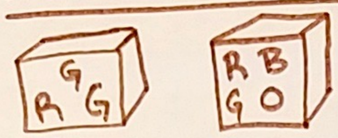

	R	B	G	O
R	RR	RB		
G			GG	
G			GG	

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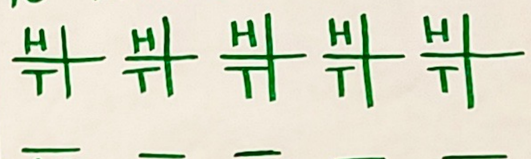

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percent, decimal

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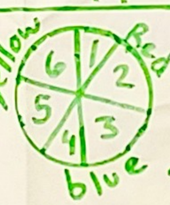
addition	mutually exclusive	When events cannot occur simultaneously	 What is the probability of the spinner landing on yellow or 3? P(yellow or 3) = P(yellow) + P(3) $\frac{1}{2} = \frac{3}{6} = \frac{2}{6} + \frac{1}{6}$	$P(A \text{ or } B) = P(A) + P(B)$ (A or B: events; A: event; B: event) ↑ Probability
multiplication	~~independent~~	One event doesn't affect the probability of the other event	Rolling Dice  What is the probability of rolling two ones? P(one and one) = P(one) · P(one) $\frac{1}{36} = \frac{1}{6} \cdot \frac{1}{6}$	$P(A \text{ and } B) = P(A) \cdot P(B)$

Standards and Mathematical Practices

- We will use experimental and theoretical probability to persevere (Keep working) in solving real-world problems.
- We will understand that the probability of mutually exclusive events occuring is the sum (−+−=−) of their probability while the probability of independent events occuring is the product (−×−=−) of their probabilities.

Inquiry

What we know...	What we want to learn...
Probability involves getting what you want.	How do you find the probability of getting a certain color on a spinner?
Probability is a chance. (the chance/likelihood something will occur.)	What is the difference between probability and odds? They are synonyms.
The chance my team will win the Super Bowl.	How do you find the probability of having a winning lottery ticket? (You have to research how many tickets are being sold. $\frac{1}{\#\text{ of tickets}}$)
Flipping a coin and getting heads. In theory, the probability is $\frac{1}{2}$.	