Grades 3-4

Probability and Statistics is one of the strands tested on the California Standards Test.

Probability is introduced in 3rd grade. Many students do not work on probability concepts in 5th grade. They return to probability in 6th grade. It is critical to spend time exploring these ideas in 4th grade.

Lesson 1: Simple Events

SDAP 4.2.0 – Students make predictions for simple probability situations
SDAP 4.2.2 – Express outcomes of experimental probability situations verbally and numerically

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The probability of an event can be described as the relationship of the number of favorable outcomes to the number of possible outcomes.

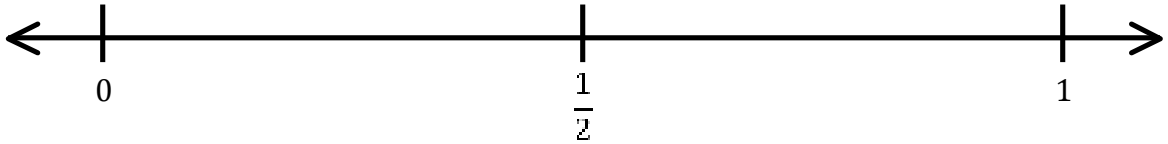
Example 1:

"Toss a coin. What are the possible outcomes? [heads or tails] If I want the coin to land on tails, tails would be my favorable outcome. On a regular coin, how many sides are tails? [1] A coin has two faces, so it has 2 possible outcomes. What is the probability of tossing a coin and getting tails?" $\left[\frac{1}{2}\right]$

"So my chances of tossing tails are 1 out of 2, or equally likely."

*Draw the number line.

Number line:



impossible……unlikely……equally likely……likely……certain

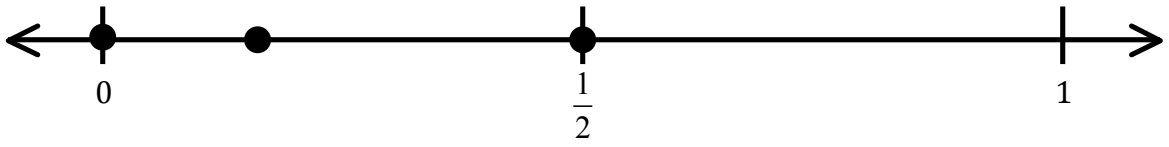
Example 2: Pass out common, six-sided dice. Have the students examine the dice.
"What is the probability for rolling a 1?" *Choral Response*: [one out of six]
"What are the probabilities for the other numbers on dice?" *Think/Pair/Share*
[students should conclude that each of the numbers 1-6 have a one in six chance]

You Try 1: Plot events on the line to describe their probability of happening.

What is the probability of rolling a 3 with a standard die? $\left[\frac{1}{6}\right]$

What is the probability of rolling an odd number with a standard die? $\left[\frac{3}{6}\right]$

What is the probability of rolling a 7 with a standard die? $\left[\frac{0}{6}\right]$



impossible……unlikely……equally likely……likely……certain

You Try 2:

Describe a roll that is certain.
[a one-digit number; a number less than 7; a positive number; etc]

Describe a roll that is likely.
[a number greater than 1; no square numbers; etc]

Example 3:

Prepare a bag or box with cubes, tiles, or marbles to represent this combination of gems: 1 diamond, 6 emeralds, 4 sapphires, and 5 rubies.

Allow a student volunteer to draw one from the bag, record the draw, and return the piece to the bag. Repeat 10 to 20 times. Have students predict what is in the bag based on the data.
Then have a group of students sort and count what is in the bag. Compare that with the predictions.

Describe the probability of drawing each gem.

[Diamond $\frac{1}{16}$; Emerald $\frac{6}{16}$ or $\frac{3}{8}$; Sapphire $\frac{4}{16}$ or $\frac{1}{4}$; Ruby $\frac{5}{16}$]

Explain that probability expresses the likelihood of an event's occurrence, but that it takes many, many trials for the data to reflect the theoretical probability of an event. *This is a concept that the students will explore further in sixth grade.*

What is the probability of drawing an Emerald or a Sapphire? $\left[\frac{6+4}{16}=\frac{10}{16}=\frac{5}{8}\right]$, likely

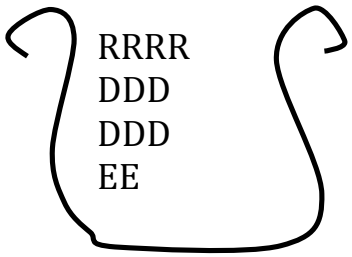
What is the probability of drawing a topaz? $\left[\frac{0}{16}\right]$, impossible

You Try 3:
prepare linker cubes, rainbow tiles, or photocopy gem sheet for groups to use

As a group find a set of gems that match the probabilities described. Then draw and label your bag of gems.

Draw a new bag with 12 gems:

- Diamonds – equally likely
- Emeralds – unlikely
- Sapphires – impossible
- Rubies - $\frac{1}{3}$



Record the probability of pulling each kind of gem from your bag. What type of gem is most likely to be picked?

If you have time design and describe a bag of your own. See if a group member can build it using your description of the probability of each gem.

Example 4:

Using a table can help you understand the possible outcomes for two separate events.

2 bags have 3 different colored blocks inside. I reach inside each and pull out a block. How many different outcomes are there?

Bag 1 ⇨ Bag 2 ⇩	Red	Blue	Yellow
Red	R R	R B	R Y
Blue	R B	B B	B Y
Yellow	R Y	B Y	Y Y

The chances of pulling Red/Blue, Red/Yellow, or Blue/Yellow are $\frac{2}{9}$

The chance of pulling Red/Red, Blue/Blue, or Yellow/Yellow is $\frac{1}{9}$

By returning the block and taking a second draw, you keep the two draws independent of one another. The first block is not influencing the chances of pulling the second block. If I were to pull 2 blocks from one bag, it would be impossible to draw Red/Red. If my first block were red $\left[\frac{1}{3}\right]$, my second block would have no chance $\left[\frac{0}{2}\right]$ of being red. When the second event is influenced by the first event, it is a dependent event. 6th graders learn about the differences between dependent and independent events and how to calculate the probability of their occurrences.

You Try 4:

What is the probability of getting a mixed set of blocks? $\left[\frac{6}{9}\right]$

What is the probability of getting a matched pair of blocks? $\left[\frac{3}{9}\right]$

What is the chance that at least one block will be yellow? $\left[\frac{5}{9}\right]$

You Try 5:

Make a table to show the outcomes for a cloudy day:

- You could bring your umbrella or leave it at home.
- It might rain or it might clear up.

	Rain	Clear
Bring Umbrella	Chose Well	Chose Poorly
Leave Umbrella	Chose Poorly	Chose Well

Lesson 2: Permutations and Multiple Simple Events

SDAP 4.2.1 – Represent all possible outcomes for simple probability situations in an organized way

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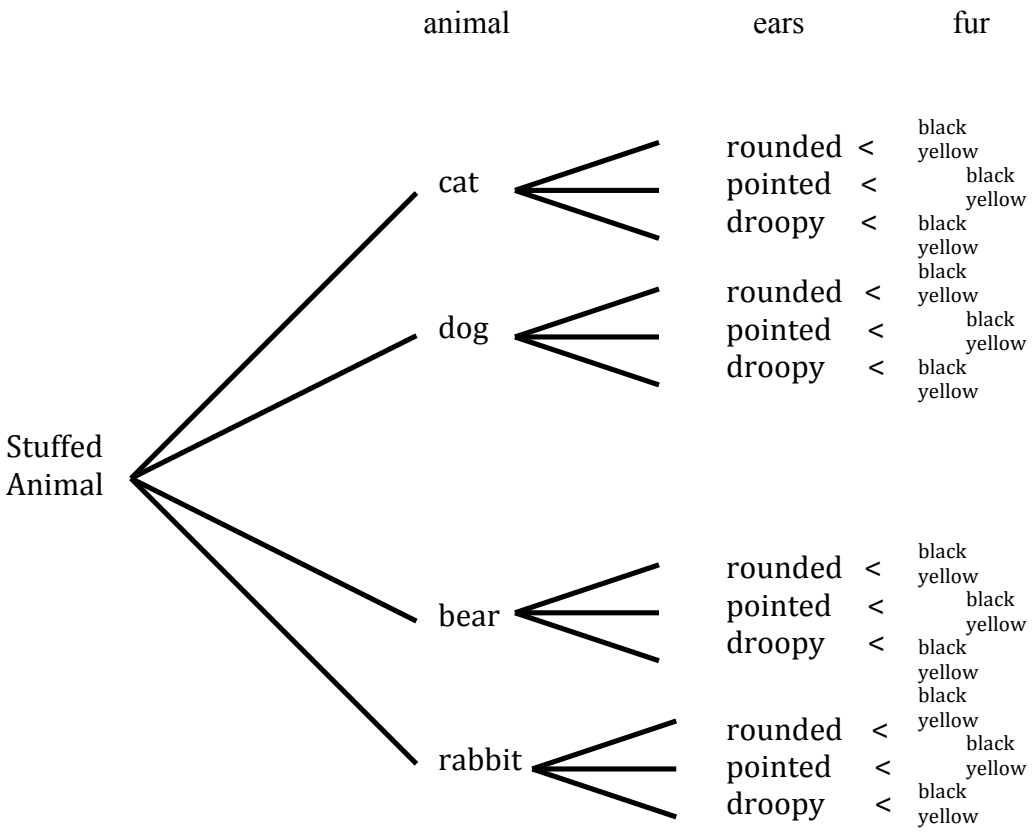
When there are more than two events or factors generating an outcome, tree diagrams will help you discover all of the possible outcomes. Then you can determine the probability of a particular outcome.

Example 1:

How many different stuffed animals can you design?

Body: cat, dog, bear, rabbit
Ears: rounded, pointed, droopy
Fur: black, yellow



This tree diagram shows that there are 6 different types of cats: black with rounded ears, yellow with rounded ears, black with pointed ears, yellow with pointed ears, black with droopy ears, and yellow with droopy ears. Likewise there are 6 types of dogs, bears, and rabbits.

In all there are 24 different combinations in this tree diagram. You can calculate the number of different combinations by multiplying the number of choices at each branching of the tree. Animals (4) Ears (3) Colors (2): $4 \bullet 3 \bullet 2 = 24$

You Try 1: Make a tree diagram that shows toy robots:

- color- red or blue
- head- round or square

color head

red < round / square

robot <

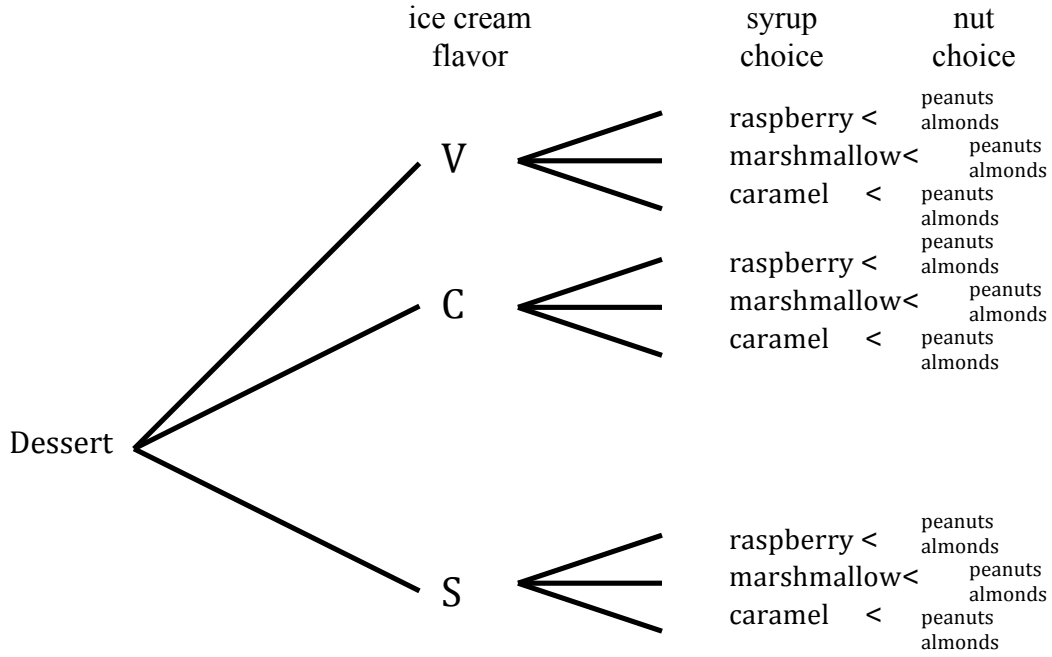
blue < round / square

How many robots did you describe? [2×2 = 4]

Example 2:

Make a tree diagram to describe the possible outcomes for a sundae:

Flavor: vanilla, chocolate, or strawberry
Syrup: raspberry, marshmallow, or caramel
Nuts: peanuts or almonds



How many combinations did you describe? [18]

You Try 2:

Write the equation that describes the combinations. [$3 \times 3 \times 2 = 18$]

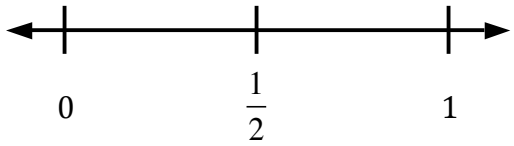
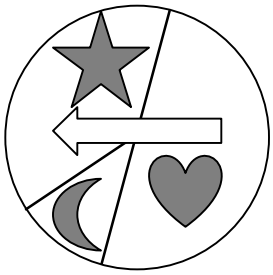
What is the probability of guessing the sundae I'd order? [$\frac{1}{18}$]

If you know vanilla is my favorite flavor, what is the probability for your guess? [$\frac{1}{6}$]

How would the tree diagram change if the number of scoops became an option? Single, double, or triple?
[another branching would be added; 54 combinations possible; $3 \times 3 \times 3 \times 2 = 54$]

Date _____

Warm-Up

CST: Grade 4 NS 1.5	Review: Grade 4 NS 1.9
Megan bought a package of 10 erasers. If 3 of the erasers are pink, what fraction of the number of erasers in this package is pink? **A** $\frac{3}{7}$ **B** $\frac{1}{3}$ **C** $\frac{3}{10}$ **D** $\frac{1}{10}$ Explain how to eliminate the other choices.	Locate $\frac{7}{12}$ on the number line below.  Is $\frac{7}{12}$ greater or less than $\frac{3}{4}$? How do you know?
Review: Grade 4 AF 1.2	**Current: Grade 4 SDAP 4.2.0**
$4 \times 2 \times 6 =$ Solve at least 2 ways.	What is the most likely result on this spinner? What is the least likely?  Draw a spinner on which all three symbols have the same chance of winning. Design and describe a third spinner.

Today's Objective/Standards: Grade 4 SDAP 4.2.1 represent all possible outcomes for simple probability situations in an organized way

Answer Key to Warm-Up

CST: Grade 4 NS 1.5

Megan bought a package of 10 erasers. If 3 of the erasers are pink, what fraction of the number of erasers in this package is pink?

A $\frac{3}{7}$

B $\frac{1}{3}$

C $\frac{3}{10}$

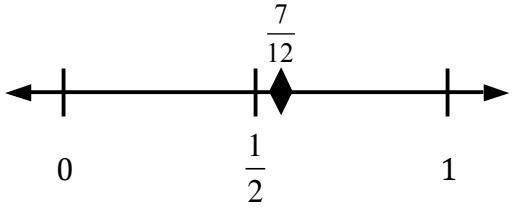
D $\frac{1}{10}$

Explain how to eliminate the other choices.

3 and 10 have no common factors other than 1, so the denominator must be 10, thus choices A and B cannot be correct. More than 1 eraser is pink, so choice D is also wrong.

Review: Grade 4 NS 1.9

Locate $\frac{7}{12}$ on the number line below.



Is $\frac{7}{12}$ greater or less than $\frac{3}{4}$? How do you know?

$$\frac{3}{4} = \frac{3}{4} \bullet \frac{3}{3}$$
$$= \frac{3 \bullet 3}{4 \bullet 3}$$
$$= \frac{9}{12}$$
$$\therefore \frac{7}{12} < \frac{3}{4}$$

Review: Grade 4 AF 1.2

$4 \times 2 \times 6 =$

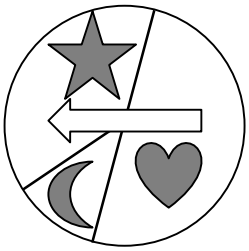
Solve at least 2 ways.

$$= (4 \times 2) \times 6$$
$$= 8 \times 6$$
$$= 48$$

$$= (6+6)+(6+6)+(6+6)+(6+6)$$
$$= 12+12+12+12$$
$$= 48$$

Current: Grade 4 SDAP 4.2.0

What is the most likely result on this spinner? What is the least likely?



Heart most likely
Moon least likely

Draw a spinner on which all three symbols have the same chance of winning. Design and describe a third spinner.

Bag of Jewels: Gems