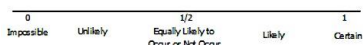


### Key Words

#### Probability

A number between 0 and 1 that represents the likelihood that an outcome will occur.



#### Probability model

A probability model for a chance experiment specifies the set of possible outcomes of the experiment—the sample space—and the probability associated with each outcome.

#### Uniform probability model

A probability model in which all outcomes in the sample space of a chance experiment are equally likely.

#### Compound event

An event consisting of more than one outcome from the sample space of a chance experiment.

#### Tree diagram

A diagram consisting of a sequence of nodes and branches. Tree diagrams are sometimes used as a way of representing the outcomes of a chance experiment that consists of a sequence of steps, such as rolling two number cubes, viewed as first rolling one number cube and then rolling the second.

#### Simulation

The process of generating “artificial” data that are consistent with a given probability model or with sampling from a known population.

#### Long-run relative frequency

The proportion of the time some outcome occurs in a very long sequence of observations.

#### Random sample

A sample selected in a way that gives every different possible sample of the same size an equal chance of being selected.

#### Inference

Using data from a sample to draw conclusions about a population.

### What Came Before this Module:

Students deepened their understanding of ratios and proportional relationship by solving a variety of percent problems. They converted between fractions, decimals, and percents to further develop a conceptual understanding of percent and used algebraic expressions and equations to solve multi-step percent problems.

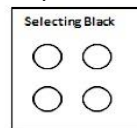
### What Comes After this Module:

Students will explore several geometry topics they have been developing over the years such as angles, area, surface area, and volume in the most challenging form students have experienced yet. Module 6 assumes students understand the basics and parts of this module are continuations of the work done in topic C of Module 3. The goal is to build a fluency in these difficult problems. The remaining topics (i.e., working on constructing triangles and taking slices (or cross sections) of three-dimensional figures) are new to students.

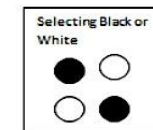
### Statistics and Probability

In this 23-lesson module, students begin their study of probability and learn how to interpret and compute probabilities in simple settings. They also learn how to estimate probabilities empirically. Additionally, students build on their knowledge of data distributions that they studied in Grade 6, compare data distributions of two or more populations, and are introduced to the idea of drawing informal inferences based on data from random samples.

#### Impossible:



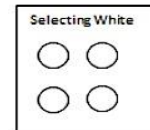
Equally Likely to Occur or Not Occur:



#### Probability

How likely is it that an event will happen?

Certain:



### Key Common Core Standards:

#### Using random sampling to draw inferences about a population.

- Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
- Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

#### Draw informal comparative inferences about two populations.

- Informally assess the degree of visual overlap of two numerical data distributions with similar variability, measuring the difference between the centers by expressing it as a multiple of a measure of variability.
- Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.

#### Investigate chance processes and develop, use, and evaluate probability models.

- Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around  $\frac{1}{2}$  indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.
- Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.
- Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
- Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

### How can you help at home?

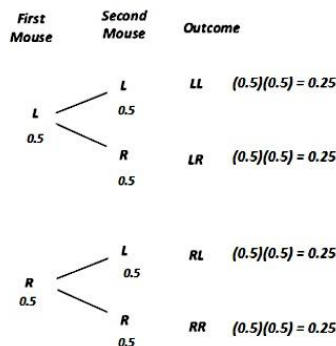
- ✓ Every day, ask your child what they learned in school and ask them to show you an example.
- ✓ Ask your child to create an example of something that is certain to happen and another event that is impossible. For example, if there is a bag containing five red crayons and you reached your hand in to grab a crayon, it is certain you will pull out a red crayon.
- ✓ Discuss the importance of random sampling in probability.

### Using Tree Diagrams to Represent a Sample Space and to Calculate Probabilities

In a laboratory experiment, two mice will be placed in a simple maze with one decision point where a mouse can turn either left (L) or right (R). When the first mouse arrives at the decision point, the direction it chooses is recorded. Then, the process is repeated for the second mouse.

Draw a tree diagram where the first stage represents the decision made by the first mouse, and the second stage represents the decision made by the second mouse. Determine all four possible decision outcomes for the two mice.

Solution:



### Using Probability to Make Decisions

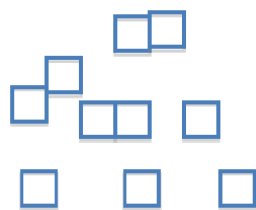
Your teacher gives you a number cube with numbers 1–6 on its faces. You have never seen that particular cube before. You are asked to state a theoretical probability model for rolling it once. A probability model consists of the list of possible outcomes (the sample space) and the theoretical probabilities associated with each of the outcomes. You say that the probability model might assign a probability of  $\frac{1}{6}$  to each of the possible outcomes, but because you have never seen this particular cube before, you would like to roll it a few times. (Maybe it's a trick cube.) Suppose your teacher allows you to roll it 500 times and you get the following results:

Outcome	1	2	3	4	5	6
Frequency	77	92	75	90	76	90

- If the “equally likely” model were correct, about how many of each outcome would you expect to see if the cube is rolled 500 times? *Solution: If the “equally likely” model were correct, you would expect to see each outcome occur about 83 times.*
- Based on the data from the 500 rolls, how often were odd numbers observed? How often were even numbers observed? *Solution: Odd numbers were observed 228 times. Even numbers were observed 272 times.*

Since the number cube clearly favors even numbers, the estimated probabilities cause doubt about the conjectured equally likely model.

### Chance Experiments



Use the picture on the left to answer the following questions.

- How would you color the cubes so it is equally likely to choose a blue or yellow cube? *Solution: Color five yellow and five blue.*
- How would you color the cubes so it is unlikely but not impossible to choose a blue cube? *Solution: Color one, two, or three blue and color the rest any other color.*