

7th Grade Math

Unit 7: Probability

7.6A, 7.6B, 7.6C, 7.6D, 7.6E, 7.6I

Understanding probability is essential for smart decision-making in everyday life. It can be used to predict the weather, or to choose the best move in a game.

- ☐ Calculate **simple probability**
- ☐ Represent **sample spaces** for simple and compound events
- ☐ Use models, such as **trees** and **tables**, to calculate probabilities
- ☐ Calculate the probability of **compound events**
- ☐ Determine whether events are **mutually exclusive** and calculate probabilities for mutually exclusive events
- ☐ Calculate probabilities from **experimental data**

START HERE

TEKS standards	Common misconceptions
7.6A: Represent sample spaces for simple and compound events using lists and tree diagrams	Confusion between fractional and decimal probabilities When calculating probabilities, students might get confused between fractional and decimal forms. They might think they represent different values or may have difficulty converting between the two. How to help: Spend time reviewing fraction/decimal conversion and fraction reduction as needed. A short warm up every day for extra practice can be beneficial and will help build fluency. Misunderstanding of equally likely outcomes Students might think that all outcomes in any random event are equally likely. How to help: Clarify that while some events are equally likely, like getting heads or tails when flipping a coin, or rolling a 1, 2, 3, 4, 5, or 6 on a fair die, that is not the case in every scenario. For example, if you are picking from a bag with 5 blue marbles and 10 red marbles, the probability of picking a blue marble ($\frac{5}{15} = \frac{1}{3}$) is different from the probability of picking a red marble ($\frac{10}{15} = \frac{2}{3}$). Ignoring total frequency Students may focus only on the favorable outcomes and might forget to consider the total number of outcomes when
7.6B: Select and use different simulations to represent simple and compound events with and without technology	
7.6C: Make predictions and determine solutions using experimental data for simple and compound events	
7.6D: Make predictions and	

determine solutions using theoretical probability for simple and compound events	calculating probability.
7.6E: Find the probabilities of a simple event and its complement and describe the relationship between the two	How to help: Review often with students that, for theoretical probability, <i>when every outcome is equally likely</i>, probability is the number of favorable outcomes divided by the total number of outcomes. Make a poster to display for quick reference. $\text{Probability} = \frac{\text{Number of favorable outcomes}}{\text{Number of outcomes}}$ Difficulty visualizing a situation It may be challenging for students to visualize what is happening in a specific scenario.
7.6I: Determine experimental and theoretical probabilities related to simple and compound events using data and sample spaces	How to help: Encourage students to draw pictures to represent a situation. As possible, provide manipulatives such as coins, dice, spinners, and bags of marbles (or other items of the same size but different color). Giving students the opportunity to act out a probability situation can help them to better understand the event. Misunderstanding randomness Students might think that outcomes of random events should alternate or avoid streaks to appear “random.” They might expect that after a certain outcome occurs, the opposite is more likely the next time. For example, if the first two flips of a coin are heads, they might think that the third flip is more likely to be tails to “balance out.” How to help: Clarify that each random event is independent and previous outcomes do not affect future ones. The probability of flipping a coin and getting heads is always 50%, no matter the outcome of the previous flip. Miscounting in probability When calculating the probability of either event A OR event B occurring (Lesson 4), students might forget to subtract the probability of both A and B occurring together. This leads to double counting outcomes. Or, students might undercount by not considering that the order doesn’t matter in certain situations. For example they may think the probability of flipping 1 head and 1 tail in a flip of 2 coins is $\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$ without counting that both (H, T) and (T, H) satisfy the situation. Since the outcomes when flipping two coins are (H, H), (H, T), (T, H), and (T, T), the probability of flipping one head and one tail is $\frac{1}{2}$. How to help: For overcounting, a Venn diagram is a helpful way to visualize why the intersection of the events must be subtracted. Encourage students to make Venn diagrams and fully label all four parts. Have students practice going back and forth between tables and Venn diagrams for the same scenario so they can see how the data appear in both types of diagrams. For undercounting, have students list the sample space to verify answers.

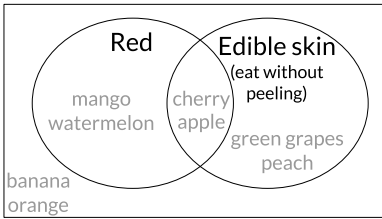
Unit resources

- For the videos in this unit, use the [Learning summary video notetaking guide](#).
- For the articles in this unit, use the [Article notetaking guide](#).
- For the exercises in this unit, use the [Blank workspace template](#).
- To record key terms and information, use the [Vocabulary and notation notetaker](#).



Lesson overview

Lesson	Objective	Teaching tips
Lesson 1: Basic probability TEKS standard: 7.6A, 7.6D, 7.6E, 7.6I Video 6 Article 0 Exercise 4	Students will be able to calculate simple probability.	• Warm up activity: To start thinking about sample space, ask students to list the possible outcomes of common simple events. For example: - List the possible outcomes when I: - Flip a coin {head or tails} - Roll a 6-sided die (include a picture) {1, 2, 3, 4, 5, or 6} • Show examples of probability notation so students are clear on what it means. When we flip a coin, the probability of getting a heads can be written as $P(\text{heads}) = \frac{1}{2}$ ("the probability of heads equals one half"). $\text{Probability} = \frac{\text{Number of favorable outcomes}}{\text{Number of outcomes}}$ • Review <i>complement</i> events together. The complement of an event is the set of all outcomes that are <i>not</i> in an event. The probability that an event <i>will</i> happen or <i>will not</i> happen equals 1. $P(\text{event}) + P(\text{complement}) = 1$ For example, the probability of rolling a 2 on a fair, 6-sided die is $P(\text{roll a 2}) = \frac{1}{6}$. The complement of rolling a 2 is <i>not</i> rolling a two, $P(\text{not a 2}) = P(1, 3, 4, 5, 6) = \frac{5}{6}$. $P(2) + P(\text{not 2}) = 1$ $\frac{1}{6} + \frac{5}{6} = 1$

Lesson 2: Probability models TEKS standard: 7.6D Video 2 Article 0 Exercise 2	Students will be able to create a probability model from observed frequencies.	- As much as possible, have resources that students can use to model the problem situations. For example, coins, dice, spinners, bags of marbles, etc. They don't need to actually simulate the situations; use them to help students understand what is <i>happening</i> in each situation. - Enforce with students that the probability of every event in the sample space must sum to 1 or 100%. If an event happens, there must be an outcome within the sample space.
Lesson 3: Compound events and sample spaces TEKS standard: 7.6A, 7.6D Video 7 Article 0 Exercise 2	Students will be able to calculate the probability of compound events.	- So far, we have been working with simple events. Now, we'll see <i>compound events</i>. A compound event is the likelihood of two or more separate events occurring at the same time or in succession. When we find the probability of a compound event, we find $\text{Probability} = \frac{\text{Favorable combinations}}{\text{Total possible combinations}}$ All of the outcomes in "total possible combinations" is the sample space. - Students will see multiple methods of listing sample spaces and solving compound probability problems: trees, tables, and 2-way tables. Review each diagram type with students. See "Best practices" for more.
Lesson 4: Venn diagrams and the addition rule TEKS standard: 7.6I Video 2 Article 0 Exercise 1	Students will be able to determine whether given events are mutually exclusive. Students will be able to calculate the probability of one event OR another event occurring.	Warm up activity: Have students fill in a Venn diagram for a topic where they can complete all four categories. For example: Fill in each area with as many fruits as you can think of:  - Review <i>mutually exclusive</i> events and discuss examples together. Mutually exclusive events cannot happen at the same time. Have students brainstorm events that are mutually exclusive and share them with the class.

Lesson 5: Experimental probability TEKS standard: 7.6C, 7.6I Video 1 Article 0 Exercise 1	Students will be able to calculate the experimental probability of an event occurring.	<i>Experimental probability</i> is when we find how likely a future event is based on our observations of past events. Even though experimental probability is based on collected data, we calculate it the same way as we've been doing so far. Note that for experimental probability, outcomes do not need to be equally likely to use this formula: $\text{Probability} = \frac{\text{Number of favorable outcomes}}{\text{Number of outcomes}}$
Lesson 6: Estimating probabilities using simulation TEKS standard: 7.6B Video 5 Article 0 Exercise 2	Students will be able to estimate probabilities and interpret results of simulations.	- Students will continue to calculate probabilities, now from simulations. Mathematically, they will do the same calculations. However, it's important to note that probabilities based on simulations are only <i>approximations</i>. - We can model non-equally likely outcomes by assigning more than one equally likely outcome in a simulation. For example, if there is a 70% probability that Taneisha will wake up before her morning alarm, we can model it with a spinner with 10 equal sections, where sections 1 to 3 represent the alarm going off first and sections 4 to 10 representing Taneisha waking up first. - Review language such as "fewer than x," "more than x," "x or more," and "x or fewer" to remind students when they include the given boundary number.

TRY THIS
WITH YOUR STUDENTS

Best practices



Compound event diagrams

When working with compound events, when two or more simple events are combined, it is helpful to make diagrams to show the sample space and find the probability of a specific outcome. We'll look at a tree diagram, table, and two-way table for the same problem scenario.

Example: What is the probability of flipping a coin two times and getting two heads?

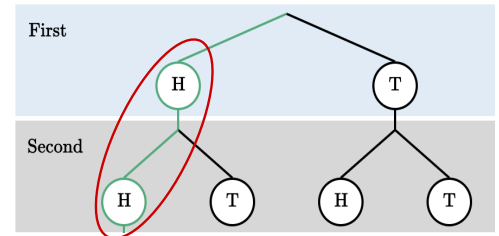
If you flip a coin two times, there are 2 possible outcomes for each individual flip, so there are $2 \times 2 = 4$ total possible outcomes. Since the coin is fair, each outcome is equally likely.

Tree diagram

Each level represents a flip of the coin and each path through the tree represents one outcome. The green path represents flipping an H and then another H.

You can see that our sample space has 4 total possible outcomes, as represented by the 2 Hs and 2 Ts in the second level.

Only one of the four paths will give us (H, H) so $P(HH) = \frac{1}{4}$.



Table

A table is really just an organized list. We'll list all of the possibilities and organize them in columns (you could organize them in rows if you wish). Each column represents one flip.

The circled outcome represents flipping H, H.

You can see that our sample space has 4 total possible outcomes, as the table has 4 rows, one for each possible outcome.

Only one of the four rows gives us (H, H), so $P(HH) = \frac{1}{4}$.

First	Second
H	H
H	T
T	H
T	T

Two-way table

Note that a two-way table can only be used when you have two events. The side of the table represents one event and the top of the table represents another event. Here, the side represents the first flip and the top represents the second flip. Each cell represents a possible outcome.

The circled outcome represents flipping H, H.

Only one of the four cells gives us (H, H), so $P(HH) = \frac{1}{4}$.

		Second	
		H	T
First	H	HH	HT
	T	TH	TT

CLASSROOM ACTIVITY

Write your own probability problem

Have students write their own probability problems. They can draw pictures or bring in manipulatives to represent the situation. Then, they can trade problems with a partner. This can be done with simple probability or compound probability.

Experiment!

Give students opportunities to do their own experiments and calculate probabilities. If all students/groups do the same experiment, you can combine class data, which should more closely approximate the theoretical probability than individual students/groups. Here are some ideas:

- Flip a coin 10 times and record the number of heads. Repeat this 10 (or more) times.
- Roll a die 10 times and record the number of 3s. Repeat this 10 (or more) times.
- With identical bags of colored marbles, have students choose 10 marbles and record the colors. Repeat this 10 (or more) times.

GENERAL CLASSROOM IMPLEMENTATION RESOURCES:

- [Weekly Khan Academy quick planning guide](#): Use this template to plan your week using Khan Academy.
- [Using Khan Academy in the classroom](#): Learn teaching techniques and strategies to support your students and save time with Khan Academy.
- [Differentiation strategies for the classroom](#): Discover strategies to support the learning of all students.