Lesson 1: Chance Experiments, Sample Spaces, and Events

Student Outcomes

- Students determine the sample space for a chance experiment.
- Given a description of a chance experiment and an event, students identify the subset of outcomes from the sample space corresponding to the complement of an event.
- Given a description of a chance experiment and two events, students identify the subset of outcomes from the sample space corresponding to the union or intersection of two events.
- Students calculate the probability of events defined in terms of unions, intersections, and complements for a simple chance experiment with equally likely outcomes.

Materials

Each group needs the following:

- Copy of rules of game
- Fair coin
- Spinner with three equal area sectors
- Spinner with six equal area sectors
- Card bag with six cards (four blue with letters *A*, *B*, *C*, and *D* and two red with letters *E* and *F*)
- Scenario cards (several per person)
- Scoring cards (several per person)

Lesson Notes

This lesson provides a review of probability topics first encountered in Grade 7. In Grade 7, students were introduced to chance experiments, events, equally likely events, and sample spaces. This lesson reviews these topics to prepare students for the more advanced probability topics developed in this grade level, which provide the foundation for inferential thinking. This lesson asks students to think about events that are described with *and*, *or*, and *not* and to identify associated outcomes from the sample space. The more formal language of intersection, union, and complement is defined in Lessons 3 and 4. The structure of this lesson is exploratory, providing several opportunities to review chance experiments, events, equally likely events, and sample spaces. The vocabulary addressed in this lesson should be familiar to some students based on their previous work. For other students, this lesson may be their first exposure to these probability topics, and an explanation of the terms is necessary.

Be prepared to carefully explain the rules and procedures of the game that is the basis of this lesson. Conduct a few practice rounds with students before they complete the exercises. Consider using parts of this lesson as an opportunity to informally assess student understanding of probability. Provide a handout of the rules for each student. (A template is provided at the end of this teacher lesson.) This relatively simple game is designed to let students calculate and interpret simple probabilities based on coins, spinners, and picking names from a bag. Teachers are encouraged to either simplify or make the game more complex based on students' experience with games. This lesson also provides an opportunity to remind students that the origins of probability were to better understand games of chance.

Before presenting this lesson, prepare copies of the two spinners (Spinners 1 and 2) and several card bags. A description of the spinners and the card bags are provided for students. Preparing the spinners and the card bags before students start the game provides more time to focus on the game and the outcomes. Spinner 1 can be constructed by tracing a large circle on an $8.5'' \times 11''$ sheet of paper. Draw three approximately equal area sectors from the center of the circle (an estimate of the center is fine for this game). Students can use a paper clip positioned at the center of the circle by the tip of a pencil or pen as the pointer. Encourage students to attempt a few spins of the paper clip before continuing with the exercises. The card bag can be a bag or jar containing six equally sized small slips of paper with four slips designated as blue and the other two slips designated as red. The letters *A*, *B*, *C*, and *D* are written on the blue slips (one letter per card), and the letters *E* and *F* are written on the red slips. Make sure that students mix up the slips of paper with each card selected and that they cannot see the cards as they make their selections.

Spinner 2 can also be constructed on an $8.5'' \times 11''$ sheet of paper with approximately six equal sectors. Spinner 2 is used in the Problem Set. Prepare a spinner template so that each student has a copy of it when completing the problems for the Problem Set.

Classwork

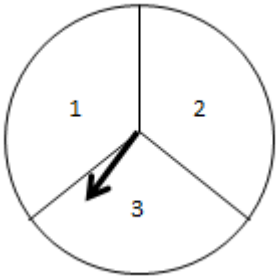
Opening (5 minutes)

Spend five minutes discussing the following game with students. Read through the explanation as a class.

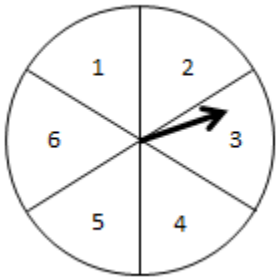
Alan is designing a probability game. He plans to present the game to people who will consider financing his idea. Here is a description of the game:

- **The game includes the following materials:**
  - **A fair coin with a head and a tail**
  - **Spinner 1 with three equal area sectors identified as 1, 2, and 3**
  - **Spinner 2 with six equal area sectors identified as 1, 2, 3, 4, 5, and 6**
  - **A card bag containing six cards. Four cards are blue with the letter *A* written on one card, *B* on another card, *C* on a third card, and *D* on the fourth card. Two cards are red with the letter *E* written on one card and the letter *F* written on the other. (Although actually using colored paper is preferable, slips of paper with the words *blue* or *red* written will also work.)**
  - **A set of scenario cards, each describing a chance experiment and a set of five possible events based on the chance experiment**

Spinner 1



Spinner 2



Card Bag:

Blue A	Blue B	Blue C	Blue D	Red E	Red F

- The game is played by two players (or two small groups of players) identified as Player 1 and Player 2.
- Rules of the game:
  - The scenario cards are shuffled, and one is selected.
  - Each player reads the description of the chance experiment and the description of the five possible outcomes.
  - Players independently assign the numbers 1–5 (no repeats) to the five events described on the scenario card based on how likely they think the event is to occur, with 5 being most likely and 1 being least likely.
  - Once players have made their assignments, the chance experiment described on the scenario card is performed. Points are then awarded based on the outcome of the chance experiment. If the event described on the scenario card has occurred, the player earns the number of points corresponding to the number that player assigned to that event (1–5 points). If an event occurs that is not described on the scenario card, then no points are awarded for that event.
  - If an outcome is described by two or more events on the scenario card, the player selects the higher point value.
  - The chance experiment is repeated four more times with points being awarded each time the chance experiment is performed.
  - The player with the largest number of points at the end of the game is the winner.

Alan developed two scenario cards for his demonstration to the finance people. A table in which the players can make their assignments and keep track of their scores accompanies each scenario card. Consider the first scenario card Alan developed.

Scenario Card 1

Game Tools: Spinner 1 (three equal sectors with the number 1 in one sector, the number 2 in the second sector, and the number 3 in the third sector)
Card bag (Blue-A, Blue-B, Blue-C, Blue-D, Red-E, Red-F)

Directions (chance experiment): Spin Spinner 1, and randomly select a card from the card bag (four blue cards and two red cards). Record the number from your spin and the color of the card selected.

Five Events of Interest:

Outcome is an odd number on Spinner 1 and a red card from the card bag.	Outcome is an odd number on Spinner 1.	Outcome is an odd number on Spinner 1 and a blue card from the card bag.	Outcome is an even number from Spinner 1 or a red card from the card bag.	Outcome is not a blue card from the card bag.

Player:

Scoring Card for Scenario 1:

Turn	Outcome from Spinner 1	Outcome from the Card Bag	Points
1			
2			
3			
4			
5			

Here is an example of Alan demonstrating the first scenario card. The chance experiment for Scenario Card 1 is "Spin Spinner 1, and record the number. Randomly select a card from the card bag (four blue cards and two red cards). Record the color of the card selected."

Alan assigned the numbers 1–5 to the descriptions, as shown below. Once a number is assigned, it cannot be used again.

Five Events of Interest:

Outcome is an odd number on Spinner 1 and a red card from the card bag.	Outcome is an odd number on Spinner 1.	Outcome is an odd number on Spinner 1 and a blue card from the card bag.	Outcome is an even number from Spinner 1 or a red card from the card bag.	Outcome is not a blue card from the card bag.
3	1	4	2	5

Alan is now ready to take his five turns. The results were recorded from the spinner and the card bag. Based on the results, Alan earned the points indicated for each turn.

Player: Player 1

Scoring Card for Scenario 1:

Turn	Outcome from Spinner 1	Outcome from the Card Bag	Points Based on Alan's Assignment of the Numbers to the Five Events
1	2	Blue	2
2	1	Red	5
3	1	Red	5
4	3	Blue	4
5	2	Blue	2

Alan earned a total of 18 points. The game now turns to Player 2. Player 2 assigns the numbers 1–5 to the same description of outcomes. Player 2 does not have to agree with the numbers Alan assigned. After five turns, the player with the most number of points is the winner.

Exploratory Challenge/Exercises 1–13 (30 minutes)

Let students work with a partner (Player 1 and Player 2) or in two small groups of players. As an Exploratory lesson, students should experiment with the game as they begin making sense of the rules and procedures. The exercises are designed to help students understand the strategy of winning the game based on analyzing the probabilities of the events.

- Let's look more closely at Scenario Card 1.

Exploratory Challenge/Exercises 1–13

1. **Would you change any of the assignments of 1–5 that Alan made? Explain your answer. Assign the numbers 1–5 to the event descriptions based on what you think is the best strategy to win the game.**

Outcome is an odd number on Spinner 1 and a red card from the card bag.	Outcome is an odd number on Spinner 1.	Outcome is an odd number on Spinner 1 and a blue card from the card bag.	Outcome is an even number from Spinner 1 or a red card from the card bag.	Outcome is not a blue card from the card bag.

Answers will vary.

Encourage students to explore different strategies for assigning the numbers, and have them share their thinking with the class. Some students may not have formed a strategy yet, and they may assign the numbers by simply guessing. Other students may have a sense of the probabilities of the various outcomes and assign numbers that reflect that thinking. The questions that follow help them organize their thinking to develop a strategy for playing the game.

2. **Carry out a turn by observing an outcome from spinning Spinner 1 and picking a card. How many points did you earn from this first turn?**

Answers will vary.

Allow students to explain to others the points they earned and how they calculated the points. This is an opportunity to review the meaning of the *or* and *and* language. The *or* (to be defined in several later lessons as a *union*) is indicating that either one or both of the descriptions is necessary for this event. The event "odd number or a red card" means that if the spinner outcome was a 1 or 3, this event has occurred regardless of the card selected. It also means that if one of the red cards was selected, and the result from the spinner is a 2, this event has occurred. The event "odd number or a red card" also occurs if the outcome is an odd number and a red card. An *and* event (for example, "odd number and a red card") means both that the number must be odd and that the card must be red.

3. **Complete four more turns (for a total of five), and determine your final score.**

Player: Your Turn

Scoring Card for Scenario 1:

Trial	Outcome from Spinner 1	Outcome from the Card Bag	Points Based on Your Assignment of Numbers to the Events
1			
2			
3			
4			
5			

Answers will vary depending on the outcomes when the student plays the game.

Use Exercise 3 to determine if students understand the directions of the game. Provide some time to discuss outcomes and to help students explain how points were obtained either with individual students or in small groups as students work through the questions.

MP.2 Encourage students to explain their reasoning in how they assigned numbers to the events and what the number of points obtained from spinning the spinner and selecting a card indicate about their decisions. Students could use the outcomes as information about which outcomes are more likely to occur.

4. **If you changed the numbers assigned to the descriptions, was your score better than Alan's score? Did you expect your score to be better? Explain. If you did not change the numbers from those that Alan assigned, explain why you did not change them.**

   Note: This question provides students an opportunity to begin explaining the strategy they are using in this game. Anticipate that in most cases students are assigning the larger numbers (the 5 or the 4) to the outcomes they think are most likely. At this point in the lesson, students have not been asked to calculate the actual probabilities of the events of interest. However, some students may have already calculated or estimated the probabilities. Anticipate that students change the assignment of numbers to try to improve their scores.

MP.3 ***As students discuss strategies for assigning numbers based on which events are most likely to occur, they are also evaluating the thinking of others.***

5. **Spinning Spinner 1 and drawing a card from the card bag is a *chance experiment*. One possible outcome of this experiment is (1, Blue-A). Recall that the *sample space* for a chance experiment is the set of all possible outcomes. What is the sample space for the chance experiment of Scenario Card 1?**

   The sample space consists of 18 outcomes.

   {(1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (1, Red-E), (1, Red-F), (2, Blue-A), (2, Blue-B), (2, Blue-C), (2, Blue-D), (2, Red-E), (2, Red-F), (3, Blue-A), (3, Blue-B), (3, Blue-C), (3, Blue-D), (3, Red-E), (3, Red-F)}

Scaffolding:

For English language learners, the term *space* may need clarification and rehearsal, as it is a noun with several meanings and also a verb.

6. **Are the outcomes in the sample space equally likely? Explain your answer.**

   Yes, each outcome is equally likely to occur because the spinner is equally likely to land in any of the three segments, and each of the six cards is equally likely to be selected. The selection of a card and the result of spinning the spinner do not depend on each other, so the 18 outcomes in the sample space should be equally likely.

7. **Recall that an *event* is a collection of outcomes from the sample space. One event of interest for someone with Scenario Card 1 is "odd number on Spinner 1 and a red card." What are the outcomes that make up this event? List the outcomes of this event in the first row of Table 1 (see Exercise 9).**

   See the completed chart in Exercise 9.

8. **What is the probability of getting an odd number on Spinner 1 and picking a red card from the card bag? Also enter this probability in Table 1 (see Exercise 9).**

   See the completed table in Exercise 9. Direct students to write their probabilities as fractions or as decimals. Fractions do not need to be reduced, as the unreduced fractions are meaningful based on the context.

9. Complete Table 1 by listing the outcomes for the other events and their probabilities based on the chance experiment for this scenario card.

The following table organizes the responses to Exercises 7–9:

Table 1

Event	Outcomes	Probability
Odd number on Spinner 1 and a red card from the card bag	*Note: If students struggle with the "and" language, discuss the outcomes with students.* *(1, Red-E), (1, Red-F), (3, Red-E), (3, Red-F)*	*The probability is $\frac{4}{18}$, which is approximately 0.222.* *Assign 1 point to this event.*
Odd number on Spinner 1	*Note: Students may indicate that the probability of this outcome is the same as the probability of just getting an odd number on the spinner without considering the color of the card selected.* *(1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (1, Red-E), (1, Red-F), (3, Blue-A), (3, Blue-B), (3, Blue-C), (3, Blue-D), (3, Red-E), (3, Red-F)*	*The probability is $\frac{12}{18}$ or $\frac{2}{3}$, which is approximately 0.667.* *Assign 5 points to this event.*
Odd number on Spinner 1 and a blue card from the card bag	*(1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (3, Blue-A), (3, Blue-B), (3, Blue-C), (3, Blue-D)*	*The probability is $\frac{8}{18}$, which is approximately 0.444.* *Assign 3 points to this event.*
Even number on Spinner 1 or a red card from the card bag	*Note: This event involves the "or." Make sure students identify all of the outcomes that apply. This is an excellent event to discuss with students.* *(1, Red-E), (1, Red-F), (2, Blue-A), (2, Blue-B), (2, Blue-C), (2, Blue-D), (2, Red-E), (2, Red-F), (3, Red-E), (3, Red-F)*	*The probability is $\frac{10}{18}$, which is approximately 0.556.* *Assign 4 points to this event.*
Not picking a blue card from the card bag	*Note: Although formally defined in Lesson 3, this is an example of the complement of the event "picking a blue card." An informal discussion of the word "complement" may be considered; however, it is not necessary at this time.* *(1, Red-E), (1, Red-F), (2, Red-E), (2, Red-F), (3, Red-E), (3, Red-F)*	*The probability is $\frac{6}{18}$, which is approximately 0.333.* *Assign 2 points to this event.*

10. Based on the above probabilities, how would you assign the numbers 1–5 to each of the game descriptions? Explain.

If players assigned the points based on a 5 assigned to the event most likely to occur, followed by 4, etc., then there would be changes made to the assignment of points.

11. If you changed any of the points assigned to the game descriptions, play the game again at least three times and record your final scores for each game. Do you think you have the best possible assignment of numbers to the events for this scenario card? If you did not change the game descriptions, also play the game so that you have at least three final scores. Compare your scores with scores of other members of your class. Do you think you have the best assignment of numbers to the events for this scenario card?

Answers will vary. A good way to discuss this question with students is to compare the score Alan received with his assignment of points and the scores students received based on their assignments of points. Based on the assignment of points described in Exercise 10, one possible student response is shown below.

MP.2 This is another opportunity for students to demonstrate their reasoning using the results of various turns, linking the assignment of numbers to events and the scores obtained.

Turn	Outcome from Spinner 1	Outcome from the Card Bag	Points Based on the Assignment of Points in Exercise 10
1	2	*Blue*	4
2	1	*Red*	5
3	1	*Red*	5
4	3	*Blue*	5
5	2	*Blue*	4

The final score for the above five turns is 23 points. This is a better score than Alan received from his assignment of points.

12. Why might you not be able to answer the question of whether or not you have the best assignments of numbers to the game descriptions with at least three final scores?

To decide the best assignment of points involves playing the game many times.

Note: Use this question to point out that probability is a long-run relative frequency. For this example, to get a good sense of the probabilities, students would need to play the game many times.

13. Write your answers to the following questions independently, and then share your responses with a neighbor:

a. How did you make decisions about what to bet on?

Answers will vary. I calculated the probability of each outcome and bet in the order of probability, 5 (greatest) to 1 (least). I used probability but changed a few bets based on the earlier outcomes.

b. How do the ideas of probability help you make decisions?

Answers will vary. Calculating probability gives you a good idea of the number of times an outcome will occur and helps you make better decisions.

Closing (5 minutes)

- How would you change the strategy of assigning the numbers 1–5 if the lowest score was the winner of the game?
  - *The event with the greatest probability will be assigned the number 1, the event with the second greatest probability would be assigned the number 2, etc. The event with the least probability will be assigned the number 5.*

Ask students to summarize the main ideas of the lesson in writing or with a neighbor. Use this opportunity to informally assess their comprehension. The Lesson Summary below offers some important ideas that should be included.

Lesson Summary

- **SAMPLE SPACE: The *sample space* of a chance experiment is the collection of all possible outcomes for the experiment.**
- **EVENT: An *event* is a collection of outcomes of a chance experiment.**
- **For a chance experiment in which outcomes of the sample space are equally likely, the probability of an event is the number of outcomes in the event divided by the number of outcomes in the sample space.**
- **Some events are described in terms of *or*, *and*, or *not*.**

Exit Ticket (5 minutes)

Name _____ Date _____

Lesson 1: Chance Experiments, Sample Spaces, and Events

Exit Ticket

1. For the chance experiment described in Scenario Card 1, why is the probability of the event "spinning an odd number and randomly selecting a blue card" not the same as the probability of the event "spinning an even number and randomly selecting a blue card"? Which event would have the greater probability of occurring, and why?

2. Why is the probability of the event "spinning an odd number from Spinner 1 *and* randomly selecting a blue card" not equal to the probability of "spinning an odd number from Spinner 1 *or* randomly selecting a blue card"?

3. If one of the red cards is changed to a blue card, what is the probability of the event "spinning an odd number from Spinner 1 and randomly selecting a red card from the card bag"?

Exit Ticket Sample Solutions

1. **For the chance experiment described in Scenario Card 1, why is the probability of the event "spinning an odd number and randomly selecting a blue card" not the same as the probability of the event "spinning an even number and randomly selecting a blue card"? Which event would have the greater probability of occurring, and why?**

   The first event includes the following outcomes from the sample space: (1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (3, Blue-A), (3, Blue-B), (3, Blue-C), (3, Blue-D).

   The second event includes the following outcomes: (2, Blue-A), (2, Blue-B), (2, Blue-C), (2, Blue-D).

   Because the spinner has two sectors representing odd numbers and only one sector representing an even number, the numbers of outcomes in the two events are different. The probability of the first event is $\frac{8}{18}$ compared to the probability of $\frac{4}{18}$ for the second event.

2. **Why is the probability of the event "spinning an odd number from Spinner 1 *and* randomly selecting a blue card" not equal to the probability of "spinning an odd number from Spinner 1 *or* randomly selecting a blue card"?**

   The outcomes for the first event must include both the odd number and a blue card or (1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (3, Blue-A), (3, Blue-B), (3, Blue-C), and (3, Blue-D). The probability of that event would be $\frac{8}{18}$, which is approximately 0.444. The outcomes of the second event would include each of the above outcomes, but it would also include the outcomes of odd numbers from the spinner with a red card and even numbers with a blue card. The outcomes for this event include (1, Blue-A), (1, Blue-B), (1, Blue-C), (1, Blue-D), (1, Red-E), (1, Red-F), (2, Blue-A), (2, Blue-B), (2, Blue-C), (2, Blue-D), (3, Blue-A), (3, Blue-B), (3, Blue-C), (3, Blue-D), (3, Red-E), and (3, Red-F). The only outcomes not included would be red cards with an even number. The probability for this event is $\frac{16}{18}$, which is approximately 0.889.

3. **If one of the red cards is changed to a blue card, what is the probability of the event "spinning an odd number from Spinner 1 and randomly selecting a red card from the card bag"?**

   Changing one red card to a blue card will result in five blue cards and one red card in the card bag. Each of the five blue cards could be paired with each odd number that is possible from the spinner (the number 1 or the number 3). There would be a total of ten outcomes for this event. The number of outcomes in the sample space, however, would not change. As a result, the probability of this event is $\frac{10}{18}$, which is approximately 0.556.

Problem Set Sample Solutions

Consider a second scenario card that Alan created for his game:

Scenario Card 2

Tools: **Spinner 1**
Spinner 2: a spinner with six equal sectors (Place the number 1 in a sector, the number 2 in a second sector, the number 3 in a third sector, the number 4 in a fourth sector, the number 5 in a fifth sector, and the number 6 in the last sector.)

Directions (chance experiment): Spin Spinner 1, and spin Spinner 2. Record the number from Spinner 1, and record the number from Spinner 2.

Five Events of Interest:

Outcome is an odd number on Spinner 2.	Outcome is an odd number on Spinner 1 and an even number on Spinner 2.	Outcome is the sum of 7 from the numbers received from Spinner 1 and Spinner 2.	Outcome is an even number on Spinner 2.	Outcome is the sum of 2 from the numbers received from Spinner 1 and Spinner 2.

Player:

Scoring Card for Scenario 2:

Turn	Outcome from Spinner 1	Outcome from Spinner 2	Points
1			
2			
3			
4			
5			

1. **Prepare Spinner 1 and Spinner 2 for the chance experiment described on this second scenario card. (Recall that Spinner 2 has six equal sectors.)**

   Prepare Spinner 2 as described. You can use the same Spinner 1 used for Scenario Card 1.

2. **What is the sample space for the chance experiment described on this scenario card?**

   There are 18 outcomes on this scenario card. Students can list all of the outcomes or describe them. Here is the list (the first number is the outcome from Spinner 1, and the second number is the outcome from Spinner 2);

   $(1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (3,1), (3,2), (3,3), (3,4), (3,5), (3,6)$

3. **Based on the sample space, determine the outcomes and the probabilities for each of the events on this scenario card. Complete the table below.**

Event	Outcomes	Probability
Outcome is an odd number on Spinner 2.	$(1,1), (1,3), (1,5), (2,1), (2,3), (2,5), (3,1), (3,3), (3,5)$	*The probability is $\frac{9}{18}$, which is 0.5.*
Outcome is an odd number on Spinner 1 and an even number on Spinner 2.	$(1,2), (1,4), (1,6), (3,2), (3,4), (3,6)$	*The probability is $\frac{6}{18}$, which is approximately 0.333.*
Outcome is the sum of 7 from the numbers received from Spinner 1 and Spinner 2.	$(1,6), (2,5), (3,4)$	*The probability is $\frac{3}{18}$, which is approximately 0.167.*
Outcome is an even number on Spinner 2.	$(1,2), (1,4), (1,6), (2,2), (2,4), (2,6), (3,2), (3,4), (3,6)$	*The probability is $\frac{9}{18}$, which is 0.5*
Outcome is the sum of 2 from the numbers received from Spinner 1 and Spinner 2.	$(1,1)$	*The probability is $\frac{1}{18}$, which is approximately 0.056.*

Note that although each event is different, some events are subsets of another event. As a result, students want to assign a larger number to the event with more outcomes. Expect that students obtain scores of 4 or 5 for each turn. As an extension, students may be asked to revise the descriptions of the events on the strategy cards in order to make the game more challenging.

4. Assign the numbers 1–5 to the events described on the scenario card.

The following assignments would be based on the 5 assigned to the event with the greatest probability (the most likely outcome), 4 to the event with the next largest, etc.:

Five Events of Interest: Scenario 2

Outcome is an odd number on Spinner 2.	Outcome is an odd number on Spinner 1 and an even number on Spinner 2.	Outcome is the sum of 7 from the numbers received from Spinner 1 and Spinner 2.	Outcome is an even number on Spinner 2.	Outcome is the sum of 2 from the numbers received from Spinner 1 and Spinner 2.
4	3	2	5	1

5. Determine at least three final scores based on the numbers you assigned to the events.

Responses will vary. Provided are three final scores based on outcomes from carrying out the game.

Player: Scott

Trial	Outcome from Spinner 1	Outcome from Spinner 2	Points (see Problem 4)
1	2	6	5
2	1	5	4
3	2	6	5
4	3	3	4
5	2	2	5

Final Score: 23 points

Player: Scott

Trial	Outcome from Spinner 1	Outcome from Spinner 2	Points (see Problem 4)
1	3	3	4
2	3	6	5
3	1	5	4
4	3	1	4
5	2	4	5

Final Score: 22 points

Player: Scott

Trial	Outcome from Spinner 1	Outcome from Spinner 2	Points (see Problem 4)
1	2	2	5
2	1	1	4
3	1	4	5
4	3	3	4
5	2	2	5

Final Score: 23 points

6. Alan also included a fair coin as one of the scenario tools. Develop a scenario card (Scenario Card 3) that uses the coin and one of the spinners. Include a description of the chance experiment and descriptions of five events relevant to the chance experiment.

Answers will vary. Encourage students to be creative with this part of their assignment. Anticipate language similar to that used in the examples. A sample response card is included.

The following is an example of a completed Scenario Card 3:

Scenario Card 3

Tools: Fair coin (head or tail)
Spinner 1 *(three equal sectors with the number 1 in one sector, the number 2 in the second sector, and the number 3 in the third sector)*

Directions (chance experiment): *Toss fair coin, and spin Spinner 1. Record the head or tail from your toss and the number from your spin.*

Five Events of Interest:

Outcome is an odd number on Spinner 1.	*Outcome is a prime number on Spinner 1.*	*Outcome is a tail.*	*Outcome is a head and is not an even number on Spinner 1.*	*Outcome is a tail and a 1 on Spinner 1.*
5	3	4	2	1

7. Determine the sample space for your chance experiment. Then, complete the table below for the five events on your scenario card. Assign the numbers 1–5 to the descriptions you created.

Evaluate this chart based on the sample space and the descriptions developed by students. To evaluate, encourage several students to explain their game scenario cards to other students, or provide a sample of the scenario cards developed for students to try. The sample response is based on the scenario card presented in Problem 6.

Event	Outcomes	Probability
Outcome is an odd number on Spinner 1.	$(1,H)$, $(1,T)$, $(3,H)$, $(3,T)$	*The probability is* $\frac{4}{6}$, *which is approximately* 0.667.
Outcome is a prime number on Spinner 1.	$(2,H)$, $(2,T)$, $(3,H)$, $(3,T)$	*The probability is* $\frac{4}{6}$, *which is approximately* 0.667.
Outcome is a tail.	$(1,T)$, $(2,T)$, $(3,T)$	*The probability is* $\frac{3}{6}$, *which is* 0.5.
Outcome is a head and is not an even number on Spinner 1.	$(1,H)$, $(3,H)$	*The probability is* $\frac{2}{6}$, *which is approximately* 0.333.
Outcome is a tail and a 1 on Spinner 1.	$(1,T)$	*The probability is* $\frac{1}{6}$, *which is approximately* 0.167.

8. Determine a final score for your game based on five turns.

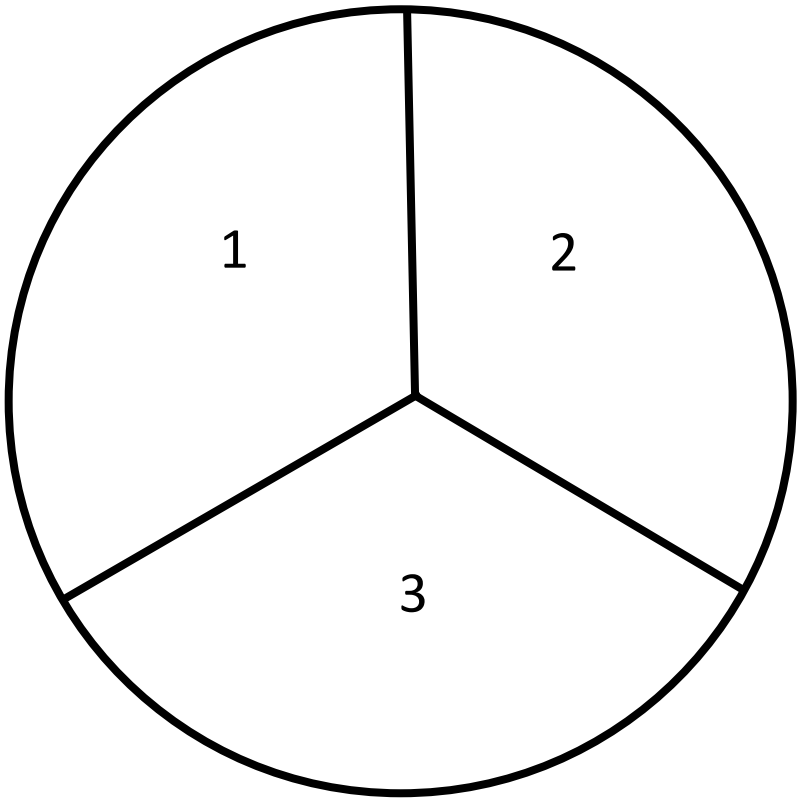
Turn			Points
1			
2			
3			
4			
5			

Answers vary based on the descriptions developed by students. Note: If time permits, encourage selected students to explain their games to other members of the class.

Rules of the game for Scenario Card 1 described in the lesson:

- The scenario cards are shuffled, and one is selected.
- Each player reads the description of the chance experiment and the description of the five events described on the scenario card.
- Players independently assign the numbers 1–5 (no repeats) to the five events described on the scenario card based on how likely they think the event is to occur, with 5 being most likely and 1 being least likely.
- Once players have made their assignments, the chance experiment described on the scenario card is performed. Points are then awarded based on the outcome of the chance experiment. If the event described on the scenario card has occurred, the player earns the number of points corresponding to the number that player assigned to that event (1–5 points). If an event occurs that is not described on the scenario card, then no points are awarded for that event.
- If an outcome is described by two or more events on the scenario card, the player selects the higher point value.
- The chance experiment is repeated four more times with points being awarded each time the chance experiment is performed.
- The player with the largest number of points at the end of the game is the winner.

Spinner 1



Spinner 2