



# GRADE 5 SUPPLEMENT

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## Set E1 Data Analysis: Probability & Technology

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### Skills & Concepts

- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

**Bridges in Mathematics Grade 5 Supplement**

**Set E1** Data Analysis: Probability & Technology

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*Bridges in Mathematics* is a standards-based K–5 curriculum that provides a unique blend of concept development and skills practice in the context of problem solving. It incorporates the Number Corner, a collection of daily skill-building activities for students.

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# Set E1 ★ Activity 1



## ACTIVITY

### Introducing Virtual Spinners

#### Overview

During this activity you'll go online with the class to introduce a virtual spinner that can be set up in a variety of ways. Today, you and the students will set up a spinner that's  $\frac{2}{3}$  one color and  $\frac{1}{3}$  another. Then students will work in pairs to conduct and record the results of an experiment with the spinner.

#### Skills & Concepts

- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

#### You'll need

- ★ Spinner Experiment (pages E1.4 and E1.5, run a class set *not* back-to-back)
- ★ computer(s)
- ★ access to the Internet (see Advance Preparation)
- ★ computer projection equipment (optional)

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**Advance Preparation** Utah State University has developed a library of free virtual manipulatives that includes a spinner feature that's fun and easy to use. You'll need to familiarize yourself with their web site and the spinner before you teach the activity. Go to <http://nlvm.usu.edu/en/nav/vlibrary.html>. Click on Data Analysis and Probability, and select Spinners. When the Spinners feature comes up, click on the "Instructions" button in the top right-hand corner and follow the directions to explore this virtual manipulative.

**Note** If you have the capacity to project the computer screen, you can conduct this activity with your whole class at the same time. If not, plan to work with small groups as time allows.

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#### Instructions for Introducing Virtual Spinners

1. Explain to students that you're going to introduce a web site that will enable them to do spinner experiments on the computer. Have them sit where they can see the screen and demonstrate how to access the Virtual Manipulatives web site. Then show them how to open Spinners.
2. When you reach the Spinners screen, take a few minutes to demonstrate how to spin the spinner and how to change the number and color of regions on the spinner.
3. Then work with input from the class to set up a spinner that's  $\frac{2}{3}$  purple and  $\frac{1}{3}$  yellow. Ask students to pair-share the probability of landing on purple if you spin the spinner just once. Invite volunteers to share their thinking with the class.

**Students** *You have a better chance of landing on purple because it takes up more than half the spinner. You have a  $\frac{2}{3}$  chance of getting purple, but only a  $\frac{1}{3}$  chance of getting yellow.*

**Activity 1** Introducing Virtual Spinners (cont.)

4. If students don't mention the terms *more* and *less likely than*, review the fact that purple is more likely than yellow to come up on one spin, and yellow is less likely than purple to come up. Two-thirds, 66.66%, and 2 out of 3 are other ways of expressing the theoretical probability of getting purple on a single spin. One-third, 33.33%, and 1 out of 3 are other ways to express the theoretical probability of getting yellow on a single spin. Spin the spinner once. What happens?
5. Now click on the Record Results button so the bar graph is visible. Ask students to make conjectures about the results of spinning the spinner 12 times. Because the spinner is two-thirds purple and one-third yellow, some may hypothesize that the spinner will land on purple 8 times and on yellow 4 times. While these figures reflect  $\frac{2}{3}$  and  $\frac{1}{3}$  of 12, remind students that the results of experiments don't always match the theoretical probabilities.
6. Ask students to help you list all the possible outcomes of 12 spins on the board.

Our spinner is  $\frac{2}{3}$  purple and  $\frac{1}{3}$  yellow.  
What are the possible outcomes of 12 spins?

- 0P, 12Y
- 1P, 11Y
- 2P, 10Y
- 3P, 9Y
- 4P, 8Y
- 5P, 7Y
- 6P, 6Y
- 7P, 5Y
- 8P, 4Y
- 9P, 3Y
- 10P, 2Y
- 11P, 1Y
- 12P, 0Y

7. Invite 12 different volunteers to click the Spin button. Then discuss the data displayed on the bar graph screen.

**Students** *It came out 7 purples and 5 yellows. I knew it would come out more purple. I was sure we'd get 8 and 4, though. Can we do it again?*

8. Click the Clear button on the bar graph screen. Then repeat step 7 and record the results of both sets of 12 spins on the board.

7P, 5Y      10P, 2Y

9. Ask students to pair up or assign partners. Explain that you're going to have them continue this experiment on their own. Give each pair a copy of the Spinner Experiment sheets. Review the instructions with the class and spend a little time discussing students' conjectures before they get started.

**Teacher** *Which outcomes do you think you'll get most and which least if you do 20 sets of 12 spins, and why?*

## Activity 1 Introducing Virtual Spinners (cont.)

**Students** *We should get 8 and 4 the most because the spinner is  $\frac{2}{3}$  and  $\frac{1}{3}$ .*

*I don't think it's all that easy to get 8 and 4. I think maybe we'll get 7 and 5 or 9 and 3 the most. You just hardly ever get exactly what you're supposed to with spinners.*

*You can get almost anything, but I don't think we're going to get all purples or all yellows very much. That just seems almost impossible.*

10. Ask student pairs to complete questions 1–3 right now and to finish the rest of the assignment when they have access to one of the computers in your classroom or in the lab.

### Extensions

- When all the pairs have completed their sheets, pool and discuss the class data. What outcomes came up the most frequently? Which came up least? Encourage students to reflect on their results and explain them the best they can.
- Have students use the Bar Chart feature on the NLVM web site to create and print out a graph of their own, or even the pooled data from the whole class. They might set up the graph to show how many times they got the 3 or 4 most frequent outcomes. The Bar Chart feature includes a place to title the graph and label the columns.



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## Spinner Experiment page 2 of 2

**2a** Before you start spinning, put stars beside the three outcomes on the chart you think you'll get most often. Record them in the space below also.

**b** Explain your answer. Why do you think you'll get those outcomes the most?

**3a** Circle the two outcomes on the chart you think you'll get *least* often. Record them in the space below also.

**b** Explain your answer. Why did you circle the 2 outcomes you did?

**4** Now start spinning. Stop at the end of 12 spins and record the outcome on the chart on the previous page. When you're finished, click the Clear button on the bar graph screen and start over. Record the outcome of each set of 12 spins on the chart until you've done 20 sets of spins. *Be sure to click the Clear button after each set.*

**5** Which outcome did you get the most? Which outcomes came in second and third place?

**6** List at least 3 other observations about your results below.

**7** How well did your results match what you thought was going to happen? Why do you think this experiment turned out the way it did?



# Set E1 ★ Activity 2



## ACTIVITY

### The 6-4-2 Spinner

#### Overview

Using the virtual spinner introduced in Activity 12, student pairs explore the idea that the more times an experiment is repeated, the more likely it is that the results will be good estimates of the theoretical probabilities.

#### Skills & Concepts

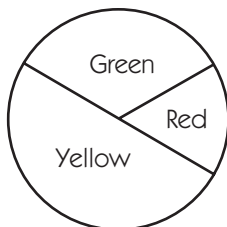
- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

#### Recommended Timing

Anytime after Set E1 Activity 1

#### Instructions for The 6-4-2 Spinner

1. Review with the class the procedures for getting to the Spinners feature on the Virtual Manipulatives web site introduced in Set E1 Activity 1.
2. When you get to Spinners click the Change Spinner button. That will take you to the Spinner Regions screen. Work with input from the class to set up the regions so there are 6 yellow, 4 green, and 2 red, and then click Apply.
3. Give students a moment to examine the spinner. Then ask them to pair-share what fraction of the spinner is occupied by each color. If they're not sure about the green and the red regions, have them count out 6 yellow, 4 green, and 2 red color tiles. Can they form a 2-by-6 rectangle that will help them determine the fractions?



|   |   |   |   |   |   |
|---|---|---|---|---|---|
| Y | Y | Y | G | G | R |
| Y | Y | Y | G | G | R |

#### You'll need

- ★ The 6-4-2 Spinner (pages E1.10–E1.12, run a class set)
- ★ computer(s)
- ★ access to the Internet (see Advance Preparation)
- ★ computer projection equipment (optional)
- ★ color tile available
- ★ calculators available

**Advance Preparation** See Set E1 Activity 1 Advance Preparation notes.

**Note** If you have the capacity to project the computer screen, you can conduct this activity with your whole class at the same time. If not, plan to work with small groups, as time allows.

**Activity 2** The 6-4-2 Spinner (cont.)

**Students** *Oh yeah! This is like when we did the tile experiment in the Number Corner. It's easy to see that half is yellow on the spinner. I wasn't sure about the green, but 4 is  $\frac{1}{3}$  of 12, and 2 is  $\frac{1}{6}$  of 12. It's kind of like the egg carton fractions too. I remember  $\frac{2}{12}$  is the same as  $\frac{1}{6}$  and  $\frac{4}{12}$  is the same as  $\frac{1}{3}$  when I look at the tiles.*

4. Now click on the Record Results button so the bar graph is visible. Ask students to make conjectures about the results of spinning the spinner 12 times. Chances are, some will believe that you'll get 6 yellows, 4 greens, and 2 reds. Others may know that the experimental results will probably not match the theoretical probabilities exactly, especially given such a small number of spins.

5. After a bit of discussion, change the number of spins on the spinner screen to read 12 instead of 1 and have a volunteer click the Spin button. What happens?

**Students** *Cool! It did all 12 spins really fast! It came out 7 yellow, 3 green, and 2 red. That's not too far away from 6, 4, and 2. Do it again!*

6. Click the Clear button on the bar graph screen. Then repeat step 5 six more times as a volunteer records the results. Your outcomes may resemble those listed below.

Trial 1: 7 Y, 3 G, 2 R

Trial 2: 4 Y, 6 G, 2 R

Trial 3: 8 Y, 4 G, 0 R

Trial 4: 8 Y, 1 G, 3 R

Trial 5: 6 Y, 4 G, 2 R

Trial 6: 4 Y, 4 G, 4 R

Trial 7: 8 Y, 2 G, 2 R

7. Discuss the results of the 7 trials with the class. What do they notice?

**Students** *It hardly ever matches 6, 4, 2. It only did that once. It went kind of backwards on Trial 4. It got 4, 6, 2 on that one. Trial 2 was weird because the spinner never landed on red at all. I think Trial 6 was pretty strange too because they all came out the same. It seems like almost anything can happen, but I bet we'll never get 0 yellows.*

8. Now ask students to speculate about what would happen if you set the number of spins at 30 instead of 12. Although half the spinner is yellow, a third is green and a sixth is red. Will these fractions be reflected in the experimental data? Some students may be fairly convinced by now that the experimental results won't match the theoretical probabilities, while others may assert that with a larger number of spins, the experimental results might be closer. Press the issue by asking students to consider the probable results of increasing the number of spins to 60, 120, 240, and 480.

**Students** *I think the more spins you do, the closer you'll get to half of them coming out yellow, a third green, and a sixth red. I think it doesn't matter. Sometimes you'll get an exact match, but most of the time it'll be way off like it was with 12 spins.*

## Activity 2 The 6-4-2 Spinner (cont.)

9. Ask students to pair up or assign partners. Explain that you're going to have them continue this experiment on their own. Give each pair a copy of The 6-4-2 Spinner sheets. Review the instructions with the class and clarify them as needed.

10. Ask student pairs to complete question 1 right now and to finish the rest of the assignment when they have access to one of the computers in your classroom or in the lab.

### Extension

- When all the pairs have completed their sheets, ask the class to discuss their findings. Does increasing the number of spins produce data that is closer to the theoretical probabilities?



### INDEPENDENT WORKSHEET

See Set E1 Independent Worksheet 1 for another probability experiment that enables students to use experimental results to make predictions.

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## The 6-4-2 Spinner page 1 of 3

**1** Computers make it possible to collect a lot of data very quickly and easily. You're going to use a virtual 6-4-2 spinner to find out what happens as you increase the number of spins from 30 to 480. To start, fill in the chart below to show the number of times you would land on each color if you always got exactly half yellow, one-third green, and one-sixth red. The first row is done for you.

| Number of Spins | $\frac{1}{2}$ of the Number | $\frac{1}{3}$ of the Number | $\frac{1}{6}$ of the Number |
|-----------------|-----------------------------|-----------------------------|-----------------------------|
| 30 spins        | 15                          | 10                          | 5                           |
| 60 spins        |                             |                             |                             |
| 120 spins       |                             |                             |                             |
| 240 spins       |                             |                             |                             |
| 480 spins       |                             |                             |                             |

**2** Follow the steps below to set up your 6-4-2 spinner.

- Go to the Virtual Manipulatives web site at <http://nlvm.usu.edu/en/nav/vlibrary.html>
- Click on Data Analysis & Probability.
- Click on Spinners.
- When you get to Spinners, click the Change Spinner button. That will take you to the Spinner Regions screen. Set up the regions so there are 6 yellow, 4 blue, and 2 green, and then click Apply.

**3** Click the Record Results button on the spinner screen, and drag the 2 screens apart so you can see your spinner and the bar graph at the same time. On the spinner screen, change the number of spins from 1 to 30 spins.

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## The 6-4-2 Spinner page 2 of 3

**4** Click the Spin button and watch what happens. Record the outcome on the chart below. Then click the Clear button on the bar graph screen and start over. Repeat this 6 more times. *Be sure to click the Clear button after each trial.*

| SPINS   |        |       |     |
|---------|--------|-------|-----|
| 30      | Yellow | Green | Red |
| Trial 1 |        |       |     |
| Trial 2 |        |       |     |
| Trial 3 |        |       |     |
| Trial 4 |        |       |     |
| Trial 5 |        |       |     |
| Trial 6 |        |       |     |
| Trial 7 |        |       |     |

**5** Compare the data you just collected with the class data for 12 spins. Do you think taking a larger number of spins makes it more likely that you'll get closer to spinning  $\frac{1}{2}$  yellow,  $\frac{1}{3}$  green, and  $\frac{1}{6}$  red? Explain your answer.

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## The 6-4-2 Spinner page 3 of 3

**6** Now test your hypothesis. Repeat step 4 for 60 spins, 120 spins, 240 spins, and 480 spins. Record all your results on the charts below.

| SPINS   |        |       |     |
|---------|--------|-------|-----|
| 60      | Yellow | Green | Red |
| Trial 1 |        |       |     |
| Trial 2 |        |       |     |
| Trial 3 |        |       |     |
| Trial 4 |        |       |     |
| Trial 5 |        |       |     |
| Trial 6 |        |       |     |
| Trial 7 |        |       |     |

| SPINS   |        |       |     |
|---------|--------|-------|-----|
| 120     | Yellow | Green | Red |
| Trial 1 |        |       |     |
| Trial 2 |        |       |     |
| Trial 3 |        |       |     |
| Trial 4 |        |       |     |
| Trial 5 |        |       |     |
| Trial 6 |        |       |     |
| Trial 7 |        |       |     |

| SPINS   |        |       |     |
|---------|--------|-------|-----|
| 240     | Yellow | Green | Red |
| Trial 1 |        |       |     |
| Trial 2 |        |       |     |
| Trial 3 |        |       |     |
| Trial 4 |        |       |     |
| Trial 5 |        |       |     |
| Trial 6 |        |       |     |
| Trial 7 |        |       |     |

| SPINS   |        |       |     |
|---------|--------|-------|-----|
| 480     | Yellow | Green | Red |
| Trial 1 |        |       |     |
| Trial 2 |        |       |     |
| Trial 3 |        |       |     |
| Trial 4 |        |       |     |
| Trial 5 |        |       |     |
| Trial 6 |        |       |     |
| Trial 7 |        |       |     |

**7** What do you think now? Does increasing the number of spins make it more likely that you'll get closer to spinning  $\frac{1}{2}$  yellow,  $\frac{1}{3}$  green, and  $\frac{1}{6}$  red? Explain your answer.

NAME \_\_\_\_\_

DATE \_\_\_\_\_

# Set E1 ★ Independent Worksheet 1



## INDEPENDENT WORKSHEET

### Make & Test Your Own Spinner

Directions:

- Go to the Virtual Manipulatives web site at:  
<http://nlvm.usu.edu/en/nav/vlibrary.html>
- Click on Data Analysis & Probability.
- Click on Spinners.
- When you get to Spinners click the Change Spinner button. That will take you to the Spinner Regions screen. Choose 3 different colors. Then decide how many regions you want for each color. The number of regions has to add up to exactly 12. For instance, you may decide to have 4 purple, 4 red, and 4 orange. Or maybe you'll choose 7 green, 3 blue, and 2 yellow. It's up to you. Click Apply.

**1** Tell what fraction of the spinner turned out to be each color. (Hint: Look back at the Spinner Regions screen. Remember that the number of regions you assigned was 12 in all. You can also use the color tile to help figure it out.)

**a** My spinner is  $\frac{\quad}{\quad}$   $\frac{\quad}{\quad}$ .  
(fraction) (color)

**b** My spinner is  $\frac{\quad}{\quad}$   $\frac{\quad}{\quad}$ .  
(fraction) (color)

**c** My spinner is  $\frac{\quad}{\quad}$   $\frac{\quad}{\quad}$ .  
(fraction) (color)

**2** What color do you think the arrow will land on if you spin the spinner 1 time? Explain your answer.

**3** Click the Spin button once. What color did the arrow land on? \_\_\_\_\_

(Continued on back.)

**Independent Worksheet 1** Make & Test Your Own Spinner (cont.)

**4** Which color do you think will come up most often if you make 100 spins? Why?

**5** Which color do you think will come up least often if you make 100 spins? Why?

**6** About how many times do you think you'll get each color if you spin the spinner 100 times? Explain your answers.

**a** I think I'll get \_\_\_\_\_ about \_\_\_\_\_ times because:

**b** I think I'll get \_\_\_\_\_ about \_\_\_\_\_ times because:

**c** I think I'll get \_\_\_\_\_ about \_\_\_\_\_ times because:

**7** Click the Record Results button on the spinner screen, and drag the 2 screens apart so you can see your spinner and the bar graph at the same time. On the spinner screen, change the number of spins from 1 to 100 spins.

(Continued on next page.)

NAME \_\_\_\_\_

DATE \_\_\_\_\_

**Independent Worksheet 1** Make & Test Your Own Spinner (cont.)

**8** Click the Spin button and watch what happens. Record the outcome on the chart below. Then click the Clear button on the bar graph screen and start over. Make 100 spins ten times and record the data on the chart. *Be sure to click the Clear button after each set.*

| Color:           | Color:           | Color:           |
|------------------|------------------|------------------|
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |
| _____ out of 100 | _____ out of 100 | _____ out of 100 |

**9** List at least 3 different observations about your data.

**10** How well did your results match what you thought was going to happen? Why do you think this experiment turned out the way it did?

