Name_____ Date _____

10.2 Experimental Design

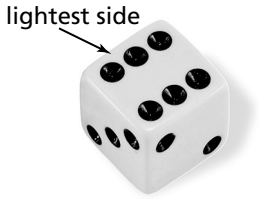
For use with Exploration 10.2

Essential Question How can you use an experiment to test a conjecture?

1 EXPLORATION: Using an Experiment

Work with a partner. Standard white playing dice are manufactured with black dots that are indentations, as shown. So, the side with six indentations is the lightest side and the side with one indentation is the heaviest side.

You make a conjecture that when you roll a standard playing die, the number 6 will come up more often than the number 1 because 6 is the lightest side. To test your conjecture, roll a standard playing die 25 times. Record the results in the table. Does the experiment confirm your conjecture? Explain your reasoning.



Number						
Rolls						

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10.2 Experimental Design (continued)

2 EXPLORATION: Analyzing an Experiment

Work with a partner. To overcome the imbalance of standard playing dice, one of the authors of this book invented and patented 12-sided dice, on which each number from 1 through 6 appears twice (on opposing sides). See *BigIdeasMath.com*.

As part of the patent process, a standard playing die was rolled 27,090 times. The results are shown below.

Number	1	2	3	4	5	6
Rolls	4293	4524	4492	4397	4623	4761

What can you conclude from the results of this experiment? Explain your reasoning.

Communicate Your Answer

3. How can you use an experiment to test a conjecture?

4. Exploration 2 shows the results of rolling a standard playing die 27,090 times to test the conjecture in Exploration 1. Why do you think the number of trials was so large?

5. Make a conjecture about the outcomes of rolling the 12-sided die in Exploration 2. Then design an experiment that could be used to test your conjecture. Be sure that your experiment is practical to complete and includes enough trials to give meaningful results.

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10.2 Practice
For use after Lesson 10.2

Core Concepts

Comparative Studies and Causality

- A rigorous randomized comparative experiment, by eliminating sources of variation other than the controlled variable, can make valid cause-and-effect conclusions possible.
- An observational study can identify *correlation* between variables, but not *causality*. Variables, other than what is being measured, may be affecting the results.

Notes:

Worked-Out Examples

Example #1

Explain whether the research topic is best investigated through an experiment or an observational study. Then describe the design of the experiment or observational study.

A restaurant chef wants to know which pasta sauce recipe is preferred by more diners.

It is best investigated through an experiment.

Sample answer: Randomly select the same number of diners to be put in each of two groups. Give pasta sauce made from one recipe to one of the groups, and give pasta sauce made from the other recipe to the other group. Keep all other variables constant and survey the diners to see if they liked the recipe they were given.

Example #2

Explain whether the research topic is best investigated through an experiment or an observational study. Then describe the design of the experiment or observational study.

You want to know whether homes that are close to parks or schools have higher property values.

It is best investigated through an observational study.

Sample answer: Randomly choose one group of homes close to parks and schools. Then randomly choose one group of homes not close to parks and schools. Find property values of homes in each group.

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10.2 Practice (continued)

Practice A

In Exercises 1 and 2, determine whether the study is a randomized comparative experiment. If it is, describe the treatment, the treatment group, and the control group. If it is not, explain why not and discuss whether the conclusions drawn from the study are valid.

1.

Baby DVDs

Baby DVDs Improves Language Ability

To test whether baby DVDs that highlight words and introduce music and art can improve language ability, parents with babies 0–24 months were given the choice of whether to let their babies watch the DVDs. Fifty babies who watched the DVDs were observed for a year as well as 50 other babies who did not watch the DVDs. At the end of the year, babies who watched the DVDs scored higher in a language development test.

2.

Type 1 Diabetes

New Drug Improves Blood Glucose Control

In a clinical trial, 100 Type 1 diabetic patients volunteered to take a new drug. Fifty percent of the patients received the drug and the other fifty percent received a placebo. After one year, the patients who received the drug had better blood glucose control while the placebo group experienced no significant change.

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10.2 Practice (continued)

In Exercises 3 and 4, explain whether the research topic is best investigated through an experiment or an observational study. Then describe the design of the experiment or observational study.

3. A criminologist wants to know whether social factors are the cause of the criminal behavior.

4. A pharmaceutical company wants to know whether the new medication on heart disease has a side effect on individuals.

5. A company wants to test the effectiveness of a new moisturizing cream designed to help improve skin complexion. Identify a potential problem, if any, with each experimental design. Then describe how you can improve it.

a. The company randomly selects ten individuals. Five subjects are given the new moisturizing cream and the other five are given a placebo. After eight weeks, each subject is evaluated and it is determined that the five subjects who have been using the cream have improved skin complexion.

b. The company randomly selects a large group of individuals. Half of the individuals are given the new moisturizing cream and the other half of the individuals may use their own existing moisturizers or none at all. After eight weeks, each subject is evaluated and it is determined that a significant large number of subjects who received the moisturizing cream have improved skin complexion.

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Practice B

In Exercises 1 and 2, determine whether the study is a randomized comparative experiment. If it is, describe the treatment, the treatment group, and the control group. If it is not, explain why not and discuss whether the conclusions drawn from the study are valid.

1. A pool cleaning service is offering a new chlorine solution to its customers. Of 90 customers, the 45 customers who chose to switch to the new chlorine solution were monitored for a year, as were the 45 customers who did not switch. At the end of the year, the customers who switched to the new chlorine solution were 30% more satisfied with the condition of their pools while those who did not switch experienced no significant change.

2. A recycling company is testing the use of recyclables containers rather than recyclables bins, in the hopes of increasing the amount of recycling. It randomly divided 150 customers into two groups. One group received the new recyclables containers, and the other group continued using their recyclables bins. After 6 months, the customers with the new recyclables containers recycled 25% more pounds of recyclables than customers with the recyclables bins.

In Exercises 3 and 4, explain whether the research topic is best investigated through an experiment or an observational study. Then describe the design of the experiment or observational study.

3. An organization wants to know whether donating 20% of one's income to charities affects one’s satisfaction with his or her job.

4. A rancher wants to know whether a new feed affects the quality of the milk produced by cows.

5. A researcher wants to test whether drinking diet soda increases sugar cravings. Identify a potential problem, if any, with each experimental design. Then describe how you can improve it.

   a. The researcher randomly selects 200 people. Half of the people drink diet soda, and the occurrence of sugar cravings is monitored. The other half of the people do not drink diet soda, and their occurrence of sugar cravings is monitored. The occurrence of sugar cravings for the people who drink diet soda is significantly higher than the occurrence of cravings for those who do not.

   b. The researcher selects 300 people. The people are divided into two groups based on exercise habits. Within each group, the people are randomly assigned to drink diet soda or to not drink diet soda. The people's sugar cravings are monitored. There is no significant difference in the occurrence of sugar cravings between the two groups.