

**10.4****Making Inferences from Experiments**

For use with Exploration 10.4

**Essential Question** How can you test a hypothesis about an experiment?

**1 EXPLORATION: Resampling Data**

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

**Work with a partner.** A randomized comparative experiment tests whether water with dissolved calcium affects the yields of yellow squash plants. The table shows the results.

Yield (kilograms)	
Control Group	Treatment Group
1.0	1.1
1.2	1.3
1.5	1.4
0.9	1.2
1.1	1.0
1.4	1.7
0.8	1.8
0.9	1.1
1.3	1.1
1.6	1.8

- a. Find the mean yield of the control group and the mean yield of the treatment group. Then find the difference of the two means. Record the results.
- b. Write each yield measurement from the table on an equal-sized piece of paper. Place the pieces of paper in a bag, shake, and randomly choose 10 pieces of paper. Call this the “control” group, and call the 10 pieces in the bag the “treatment” group. Then repeat part (a) and return the pieces to the bag. Perform this resampling experiment five times.
- c. How does the difference in the means of the control and treatment groups compare with the differences resulting from chance?

**10.4 Making Inferences from Experiments (continued)****2 EXPLORATION: Evaluating Results**

**Work as a class.** To conclude that the treatment is responsible for the difference in yield, you need strong evidence to reject the hypothesis:

*Water dissolved in calcium has no effect on the yields of yellow squash plants.*

To evaluate this hypothesis, compare the experimental difference of means with the resampling differences.

- Collect all the resampling differences of means found in Exploration 1(b) for the whole class and display these values in a histogram.
- Draw a vertical line on your class histogram to represent the experimental difference of means found in Exploration 1(a).
- Where on the histogram should the experimental difference of means lie to give evidence for rejecting the hypothesis?
- Is your class able to reject the hypothesis? Explain your reasoning.

**Communicate Your Answer**

- How can you test a hypothesis about an experiment?
- The randomized comparative experiment described in Exploration 1 is replicated and the results are shown in the table. Repeat Explorations 1 and 2 using this data set. Explain any differences in your answers.

	Yield (kilograms)									
Control Group	0.9	0.9	1.4	0.6	1.0	1.1	0.7	0.6	1.2	1.3
Treatment Group	1.0	1.2	1.2	1.3	1.0	1.8	1.7	1.2	1.0	1.9

# 10.4

## Practice

For use after Lesson 10.4

Notes:

### Worked-Out Examples

#### Example #1

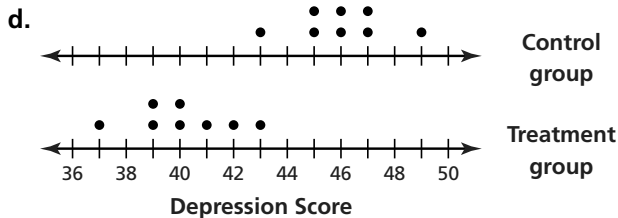
**PROBLEM SOLVING** A randomized comparative experiment tests whether music therapy affects the depression scores of college students. The depression scores range from 20 to 80, with scores greater than 50 being associated with depression. The control group has eight students and the treatment group, which receives the music therapy, has eight students. The table shows the results.

- Find the mean score of the control group.
- Find the mean score of the treatment group.
- Find the experimental difference of the means.
- Display the data in a double dot plot.
- What can you conclude?

	Depression Score			
<b>Control Group</b>	49	45	43	47
<b>Treatment Group</b>	39	40	39	37

<b>Control Group</b>	46	45	47	46
<b>Treatment Group</b>	41	40	42	43

- The mean of the control group is  $\bar{x} = \frac{368}{8} = 46$ .
- The mean of the treatment group is  $\bar{x} = \frac{321}{8} = 40.125$ .
- The experimental difference of the means is  $40.125 - 46 = -5.875$ .



- The plot of the data shows that the two data sets tend to be fairly symmetric and have no extreme values. So, the mean is a suitable measure of center. You can conclude that the music therapy may be effective in reducing depression scores of college students.

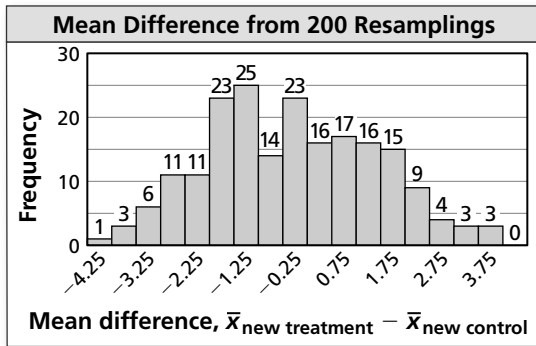
**10.4 Practice (continued)**

**Example #2**

**DRAWING CONCLUSIONS** To analyze the hypothesis below, use the histogram which shows the results from 200 resamplings of the data in Exercise 3.

**Music therapy has no effect on the depression score.**

Compare the experimental difference in Exercise 3 with the resampling differences. What can you conclude about the hypothesis? Does music therapy have an effect on the depression score?



You can conclude that the hypothesis is most likely false. So, the music therapy decreases depression scores.

**Practice A**

1. A randomized comparative experiment tests whether students who are given weekly quizzes do better on the comprehensive final exam. The control group has 10 students and the treatment group, which receives weekly quizzes, has 10 students. The table shows the results.

	Final Exam Scores (out of 100 points)									
<b>Control Group</b>	82	55	76	92	76	76	82	58	69	79
<b>Treatment Group</b>	92	90	88	73	88	63	94	81	81	77

- a. Find the mean score of the control group.
- b. Find the mean score of the treatment group.
- c. Find the experimental difference of the means.

**10.4 Practice (continued)**

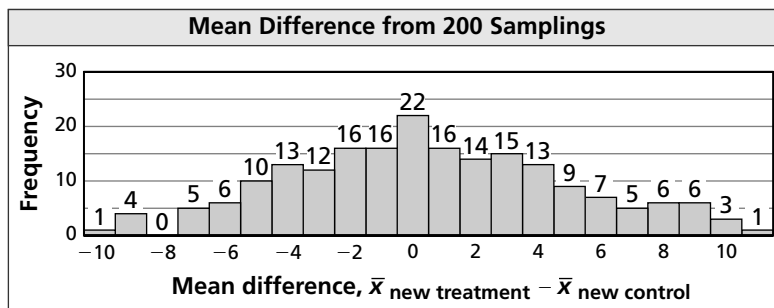
- d. Display the data in a double dot plot.
  - e. What can you conclude?
2. Resample the data in Exercise 1 using a simulation. Use the means of the new control and treatment groups to calculate the difference of the means.

		Final Exam Scores (out of 100 points)									
<b>New Control Group</b>											
<b>New Treatment Group</b>											

3. To analyze the hypothesis below, use the histogram which shows the results from 200 resamplings of the data in Exercise 1.

*Weekly Quizzes have no effect on final exam scores.*

Compare the experimental difference in Exercise 1 with the resampling differences. What can you conclude about the hypothesis? Do weekly quizzes have an effect on final exam scores?



## Practice B

1. A randomized comparative experiment tests whether photo therapy affects the size of the area of skin irritations. The control group has eight patients and the treatment group, which receives the photo therapy, has eight patients. The table shows the results.

	Area of Skin Irritation (square centimeters)							
Control Group	4.2	1.3	5.1	3.4	2.7	4.1	3.6	2.4
Treatment Group	1.2	2.5	4.1	3.7	2.1	1.5	2.4	1.9

- Find the mean area of the control group.
- Find the mean area of the treatment group.
- Find the experimental difference of the means.
- Display the data in a double dot plot.
- What can you conclude?
- Resample the data using a simulation.
- Find the mean score of the new control group.
- Find the mean score of the new treatment group.
- Find the experimental difference of the new means.