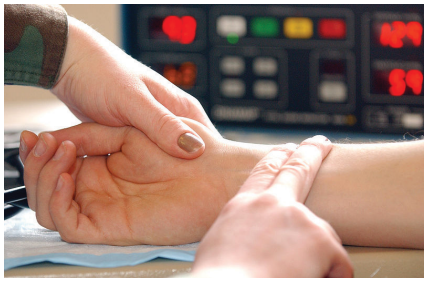
Unit 8, Lesson 15

Heart Rates

Let's collect and analyze data.

15.1 Find Your Heart Rate

Find your heart rate. One way is to place your index and middle fingers on your neck just below the jaw to feel your heartbeat. Count the number of heartbeats you feel in 10 seconds. Multiply the value by 6 to find your heart rate in beats per minute (bpm).



1. Write the value for your heart rate in bpm. This will be used as your resting heart rate.

2. Take some deep breaths, close your eyes, and find your heart rate again. Write the value for your heart rate in bpm. Has your heart rate changed?

15.2 The Counting Experiment

Does counting affect how much your heart rate increases? Let's perform an experiment to find out.

1. Your teacher will divide you into two groups and lead the activity. If you are selected to be in the group that will count during the activity, count out loud together with your group while you do the activity. If you are selected to be in the group that will remain silent during the activity, remain quiet.
2. Immediately following the activity, measure your heart rate again. Count the number of beats in 10 seconds, and multiply the result by 6 to get your heart rate in beats per minute. Record this result. Find the difference in heart rate by subtracting your heart rate after exercise from the resting heart rate you found during the *Warm-up*.

15.3 The Partial Experiment

Does the way you do an activity affect your heart rate? Let's perform an experiment to find out.

1. Your teacher will help divide you into two groups and lead the activity.
2. Immediately following the activity, measure your heart rate again. Count the number of beats in 10 seconds, and multiply the result by 6 to get your heart rate in beats per minute. Record this result. Find the difference in heart rate by subtracting your heart rate after exercise from the resting heart rate you found during the *Warm-up*.

15.4 Analyzing the Heart Rates

1. Using the data for the increase in heart rates, find the mean for each group.

2. Find the difference between the means for the two groups by subtracting the mean for the second group from the mean for the first group. What does a positive value mean? What does a negative value mean?

3. Does the difference in means provide evidence that the treatment has an effect on heart rate? If so, explain the connection. If not, what else could account for the difference in means?

4. Because the groups were divided using a random process, the only reason there should be a difference in means is if the treatment had an effect or if the difference was due merely to the randomness involved in the process. To rule out the possibility that the treatment had no effect on heart rate, assume for the moment that was the situation. Then our assignment into groups by treatment is just one of many different ways the data could have been grouped, and we can compare our observed difference to what we would expect to observe from any random assignment. Let's examine what happens when we do this randomization experiment.
    a. Cut a sheet of paper into pieces so there are enough to write the increase in heart rate on each piece. Write the data from the experiment on the papers so that each piece has 1 value on it.
    b. Shuffle the pieces and select some of them to represent the first group. Give the other pieces to your partner to represent the second group so that the two groups are the same sizes as your original groups.
    c. Find the mean for each group, and record the difference in the means by subtracting the mean for the second group from the mean for the first group.
    d. Put the papers all together again, and then repeat this process 4 more times so that you have recorded 5 differences in means from the randomization process.

5. Share your data with the class, and examine the randomization distribution in the histogram of the difference in means. This distribution represents some of the differences that are possible even if the treatment had no effect. Why should our distribution be centered around 0?

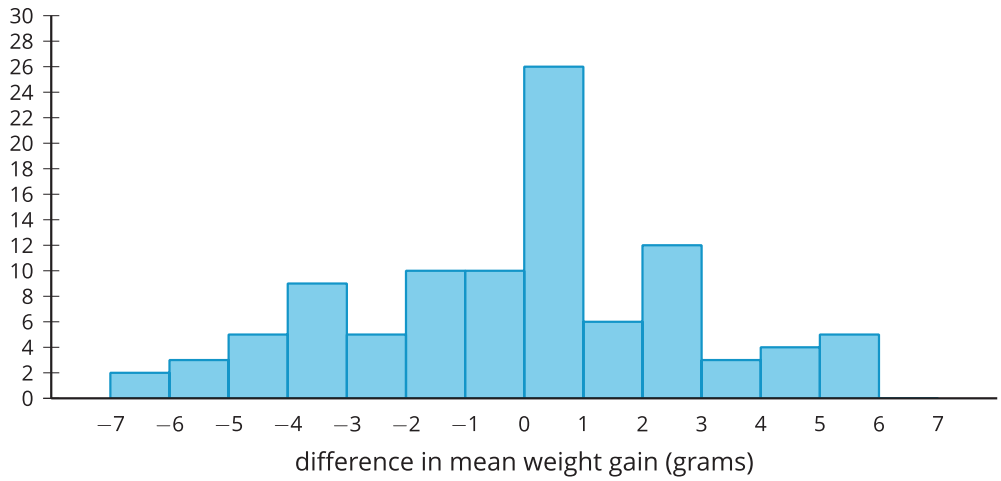
6. Does the difference for your class from the actual experiment represent a typical value for this distribution, or is it unusual?

Lesson 15 Summary

A randomization distribution is used to determine if the difference between the means of different treatment groups could be due to chance.

A company farms a type of fish called tilapia. They conduct an experiment to determine if a freshwater environment, Treatment A, or a slightly salty environment, Treatment B, causes the fish to grow at a faster rate (measured by weight gained by the fish). The table displays the weight gain, in grams, of a random sample of 11 tilapia from Treatment A and a random sample of 11 tilapia from Treatment B.

Treatment A weight gain (grams)	Treatment B weight gain (grams)
120	120
125	130
115	135
135	125
110	135
125	125
130	130
120	130
125	125
120	135
125	130



The results for 100 trials of simulating redistributing the data are summarized in the histogram.

The mean weight gain of the sample from Treatment A is approximately 122.7 grams, and the mean weight gain of the sample from Treatment B is approximately 129.1 grams, a difference of approximately -6.4 grams.

Only 2 out of 100 trials for the simulation show a weight gain difference between the groups of at least 6 grams. Because the difference between the mean weight gains from the treatment groups is -6.4 grams, we can say we have good evidence that the difference did not occur by chance. Therefore, there is evidence that the saltiness of the water in which the tilapia are grown does have an effect on the weight gain of the fish grown in that environment.