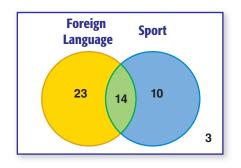# Two-Way Tables

SCHOOL The data from a survey of 50 students is shown in the Venn diagram. The students were asked whether or not they were taking a foreign language and whether or not they played a sport.

1. How many students are taking a foreign language?
2. How many students play a sport?
3. How many students do both?
4. How many students do not play a sport and do not take a foreign language?
5. How many students play a sport but do not take a foreign language?

A two-way table is similar to a Venn diagram. A **two-way table** shows data that pertain to two different categories. The data from one sample group is shown as it relates to two different categories.

The same information from the Venn diagram above is shown below as a two-way table, where one category is represented by rows and the other category is represented by columns.

	Play a Sport	Do Not Play a Sport	Total
Take a Foreign Language	14	23	14 + 23 or 37
Do Not Take a Foreign Language	10	3	10 + 3 or 13
Total	14 + 10 or 24	23 + 3 or 26	50

The totals shown are for the corresponding row or column with a grand total of 50 students in the data set.

In this lesson, you will learn how to construct and analyze two-way tables from words and diagrams.

Construct a Two-Way Table

1 **TECHNOLOGY** Felipe surveyed students at his school. He found that 78 students own a cell phone and 57 of those students own an MP3 player. There are 13 students that do not own a cell phone, but own an MP3 player. Nine students do not own either device. Construct a two-way table summarizing the data.

Step 1 Create a table using the two categories: cell phones and MP3 players.

	MP3 Player	No MP3 Player	Total
Cell Phone			
No Cell Phone			
Total			

Step 2 Use the values given to fill in the table.

	MP3 Player	No MP3 Player	Total
Cell Phone	57		78
No Cell Phone	13	9	
Total			

Step 3 Use reasoning to complete the table. Remember, the totals are for each row and column. The column labeled "Total" should have the same sum as the row labeled "Total."

	MP3 Player	No MP3 Player	Total
Cell Phone	57	21	78
No Cell Phone	13	9	22
Total	70	30	100

✓ **CHECK Your Progress**

a. SUMMER CAMP There are 150 children at summer camp and 71 signed up for swimming. There were a total of 62 children that signed up for canoeing and 28 of them also signed up for swimming. Construct a two-way table summarizing the data.

Real-World Link
There are about 12,000 summer camps across the United States.

A two-way table can also show relative frequencies. **Relative frequency** is the ratio of the value of a subtotal to the value of the total. In Example 1, the relative frequency of students who own a cell phone who also own an MP3 player is $\frac{57}{78}$ or about 0.73.

$\frac{57}{78}$ ◄— number of students who own a cell phone and an MP3 player
◄— total number of students

A two-way table can show relative frequencies for rows or for columns, rather than the actual values.

SCHOOL Using the two-way table from the beginning of the lesson, find the relative frequencies by row and then by column.

2 What is the relative frequency of students that take a foreign language and play a sport to all students taking a foreign language?

To find the relative frequencies by row, write the ratios of each value to the total in that row. Round to the nearest hundredth if necessary.

Frequency by Row	Play a Sport	Do Not Play a Sport	Total
Take a Foreign Language	$\frac{14}{37} \approx 0.38$	$\frac{23}{37} \approx 0.62$	1.00
Do Not Take a Foreign Language	$\frac{10}{13} \approx 0.77$	$\frac{3}{13} \approx 0.23$	1.00
Total	$\frac{24}{50} = 0.48$	$\frac{26}{50} = 0.52$	1.00

The relative frequency is $\frac{14}{37}$ or about 0.38.

3 What is the relative frequency of students that neither play a sport nor take a foreign language to all students that do not play a sport?

When creating a two-way table with relative frequencies by column, use the total of the columns when writing the ratios.

Frequency by Column	Play a Sport	Do Not Play a Sport	Total
Take a Foreign Language	$\frac{14}{24} \approx 0.58$	$\frac{23}{26} \approx 0.88$	$\frac{37}{50} = 0.74$
Do Not Take a Foreign Language	$\frac{10}{24} \approx 0.42$	$\frac{3}{26} \approx 0.12$	$\frac{13}{50} = 0.26$
Total	1.00	1.00	1.00

The relative frequency is $\frac{3}{26}$ or about 0.12.

✓ CHECK Your Progress

b. TRAVEL A class was surveyed about whether they have been to Canada or Mexico. Find the relative frequencies by row and then by column for the two-way table shown. Round to the nearest hundredth if necessary. What is the relative frequency of a student who has been to both Canada and Mexico to all students that have been to Mexico?

	Have Been to Canada	Have Not Been to Canada	Total
Have Been to Mexico	6	3	9
Have Not Been to Mexico	5	11	16
Total	11	14	25

Example 1   Use the information to construct a two-way table.

1. **SURVEY** Eloise surveyed the students in her cafeteria and found that 38 males agree with the new cafeteria rules while 70 do not. There were 92 females surveyed and 41 of them agree with the new cafeteria rules.

Examples 2 and 3   2. **NEWS** The two-way table shows how some students get their news.

	TV	Internet
7th grade	13	49
8th grade	20	68

a. How many students were surveyed?

b. What is the relative frequency of students that responded TV to the total number of students surveyed? Round to the nearest hundredth if necessary.

c. Do a higher percent of 7th graders or 8th graders get their news from the Internet? Justify your response.

Practice and Problem Solving

Use the information to construct a two-way table.

Example 1   3. **FOOD** There were 100 customers in a restaurant that were asked whether they liked chicken or beef and whether they liked rice or pasta. Out of 30 customers that liked rice, 20 liked chicken. There were 60 customers that liked chicken.

4. **MOVIES** As each person entered the theater, Aaron counted how many of the 105 people had popcorn and how many had a drink. He found that out of 84 people that had popcorn, only 10 did not have a drink. Six people walked in without popcorn or a drink.

Examples 2 and 3   5. **ALLOWANCE** The two-way table shows the number of students that do or do not do chores at home and whether they receive an allowance or not.

	Allowance	No Allowance
Do Chores	13	3
Do Not Do Chores	5	4

a. How many total students do chores?

b. What is the relative frequency of students that do chores and get an allowance to the number of students that do chores? Round to the nearest hundredth if necessary.

c. What is the relative frequency of students that do not do chores nor get an allowance to the total number of students? Round to the nearest hundredth if necessary.

6. SCHOOL The two-way table shows the number of Sasha's soccer teammates that are in her Math class and English class.

	Math Class	Not in Math Class
English Class	4	2
Not in English Class	1	3

a. How many teammates does Sasha have?

b. What is the relative frequency of teammates that are in both of Sasha's classes to all of her teammates?

c. Of the teammates in her math class, which percentage is higher: the percentage of teammates that are in her English class or the percentage of teammates that are not in her English class?

7. MESSAGING The results of a survey show the number of 7th graders and the number of 8th graders that message on a daily basis. Find the relative frequencies by row and then by column. Round to the nearest hundredth if necessary.

	Text Message	Instant Message
7th graders	46	38
8th graders	59	41

8. VOLUNTEERING The two-way table shows the places that males and females volunteered in the past month. Do a higher percentage of males or females volunteer at the animal shelter? Justify your response.

	Males	Females
Animal Shelter	26	21
Hospital	13	17
Library	9	14

9. EXERCISE The Venn diagram shows the number of students that exercise in different ways. Construct a two-way table that displays the data. What is the relative frequency of the number of students that jog and do aerobics to the total number of students? Round to the nearest hundredth if necessary.

10. LUNCH Cali surveyed the students in the cafeteria about the number of times they bring their lunch to school per month. The table shows her findings. Construct a two-way table that shows the relative frequencies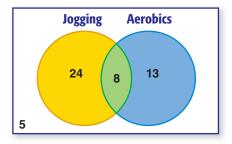 by columns. What is the relative frequency of the number of girls that bring their lunch to school less than 6 times a month to the total number of students surveyed? Round to the nearest hundredth if necessary.

Number of Times per Month	Males	Females
0–5	35	25
6–10	23	16
11–15	22	13
16–20	18	8

H.O.T. Problems

11. **OPEN ENDED** Survey your classmates to find out what kinds of after school jobs they prefer. Make a two-way table that displays your results.

12. **CHALLENGE** The two-way table below shows the number of students with each hair color and eye color.

		Hair Color				
		Black	**Brown**	**Red**	**Blond**	**Total**
Eye Color	**Brown**	7	12	3	1	23
	Blue	2	8	2	9	21
	Hazel	2	5	1	1	9
	Green	1	3	1	2	7
	Total	12	28	7	13	60

Which is greater: the percentage of the brown-haired students with blue eyes or the percentage of the red-haired students with brown eyes?

13. **WRITE MATH** Refer to Example 2. Explain how to find the relative frequency of students that do not take a foreign language but play a sport to the students that do not take a foreign language.

Test Practice

14. The two-way table below shows the number of hours students studied and whether they studied independently or with a study group.

	Studied Less Than 2 Hours	**Studied More Than 2 Hours**
Studied Independently	12	4
Studied with a Study Group	8	11

What is the relative frequency of students that studied independently for more than 2 hours to the total number of students that studied independently?

A. 0.4

B. 0.33

C. 0.25

D. 0.11

15. THINK SOLVE EXPLAIN **SHORT RESPONSE** The Pep Club was asked to vote for which dinner they would like for their banquet. Construct a two-way table for the information shown in the Venn diagram below.

Lasagna   Tacos

19   13   11

5