

Lesson 16

Two-Way Tables

Main Idea

Construct and interpret two-way tables.

New Vocabulary

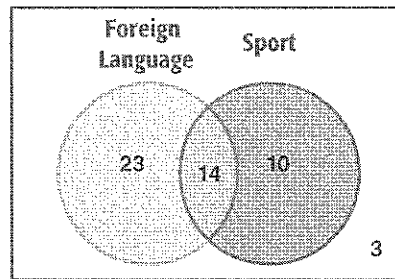
two-way table
relative frequency

Math Online

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8.SP.4

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.

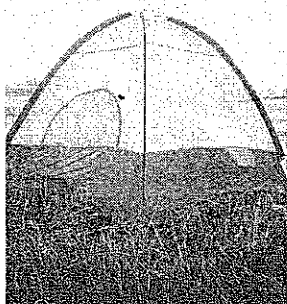
	Play a Sport	Do Not Play a Sport	Total
Take a Foreign Language	14	23	14 + 23 or 37
Do Not Take a Foreign Language	10	3	10 + 3 or 13
Total	14 + 10 or 24	23 + 3 or 26	50

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.

EXAMPLE 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.



2 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.

$$\frac{57}{78} \leftarrow \begin{array}{l} \text{number of students who own a cell phone and an MP3 player} \\ \text{total number of students} \end{array}$$

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

EXAMPLE Relative Frequencies in a Two-Way Table

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?

QUICK Review

When the numerator and denominator of a fraction are equal, the decimal equivalent is 1.00.

- 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?

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

CHECK Your Understanding

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
7 th grade	13	49
8 th 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.

Example Question

Emma has collected information about the cats and dogs that children in her class have as pets. There are 30 pupils. For each pupil, there are four possible responses they could make:

- The pupil has a cat and a dog.
- The pupil has a cat but not a dog.
- The pupil has a dog but not a cat.
- The pupil does not have a cat or a dog.

This information can be represented in the table below.

	Has a dog	Does not have a dog
Has a cat	<i>These pupils have both a cat and a dog</i>	<i>These pupils have a cat but not a dog</i>
Does not have a cat	<i>These pupils have a dog but not a cat</i>	<i>These pupils do not have a cat or a dog</i>

When Emma has entered some of her data, the table looks like this:

	Has a dog	Does not have a dog
Has a cat	8	4
Does not have a cat	12	

Emma has missed out one of the numbers, but we know that there are 30 pupils in her class.

Practice Questions

Work out the answer to each of these questions

- How many pupils do not have a cat or a dog?
- How many pupils have a dog?
- How many pupils have a cat?
- How many children have at least one of these pets?

Question 1

People leaving a football match were asked if they supported Manchester United or Newcastle. They were also asked if they were happy. The table below gives the results.

	Manchester United	Newcastle
Happy	40	8
Not Happy	2	20

(a) How many Manchester United supporters were happy?

(b) How many Newcastle supporters were asked the questions?

(c) How many Manchester United supporters were not happy?

(d) How many people were asked the questions in total?

Question 2

The children in a class conducted a survey to find out how many children had videos at home and how many had computers at home. Their results are given in the table below.

	Video	No Video
Computer	8	2
No Computer	20	3

(a) How many children did *not* have a video at home?

(b) How many children had a computer at home?

(c) How many children had *neither* item at home?

(d) How many children were in the class?

Question 3

The children in a school are to have extra swimming lessons if they cannot swim. The table below gives information about the children in Years 7, 8 and 9.

	Can swim	Can not swim
Year 7	120	60
Year 8	168	11
Year 9	172	3

(a) How many children need swimming lessons?

(b) How many children are there in Year 8?

(c) How many of the Year 7 children *can not* swim?

(d) How many children in Years 7 and 8 *can* swim?

(e) How many children are there altogether in Years 7, 8 and 9?

Question 4

40 children are members of a cycling club. Details of their bikes are given below. Each child has one bike.

	Mountain Bike	Racing Bike	BMX Bike
15-speed	2	0	0
12-speed	8		0
10-speed	1	8	0
1-speed	0	0	15

(a) Fill in the number of 12-speed racing bikes on the table.

(b) How many children have mountain bikes?

(c) Which type of bike is the most popular?

.....

Question 5

The headteacher of a school with 484 pupils collected information about how many of the pupils wear glasses.

	Always wear glasses	Sometimes wear glasses	Never wear glasses
Boys	40	<input type="text"/>	161
Girls	36	55	144

(a) Fill in the number of boys who sometimes wear glasses.

(b) How many pupils wear glasses some of the time?

(c) How many pupils *never* wear glasses?

(d) Are there more boys or girls in the school?

Question 6

During one month, exactly half of the 180 babies born in a hospital were boys, and 40 of the babies weighed 4 kg or more. There were 26 baby boys who weighed 4 kg or more.

	Less than 4kg	4kg or more
Boys		
Girls		

Complete the table on the left, using the information above.

Question 7

In a school survey pupils chose the TV programme they liked best from a list. Some of the results are given in the table below.

	Blue Peter	Grange Hill	Newsround
Year 7	8	<input type="text"/>	1
Year 8	12	5	<input type="text"/>

The same number of pupils took part in Year 7 and Year 8.

Six pupils chose Newsround in total.

(a) Complete the table and then check:

- (i) the number of Year 7 pupils who chose Grange Hill
- (ii) the number of Year 8 pupils who chose Newsround

(c) Which programme was the most popular?

For these last two questions, you will need to draw your own two-way table on paper.

Question 8

In a car showroom there are 8 blue cars, one of which is a hatchback. 6 of the 20 cars in the showroom are hatchbacks.

How many cars are *not* hatchbacks and are *not* blue?

Question 9

In a class of 32 pupils, there were 8 girls who played hockey and 5 boys who did not.

How many boys played hockey if there were 15 girls in the class?

Practice

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

- How many teammates does Sasha have?
- What is the relative frequency of teammates that are in both of Sasha's classes to all of her teammates?
- 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
7 th graders	46	38
8 th 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.

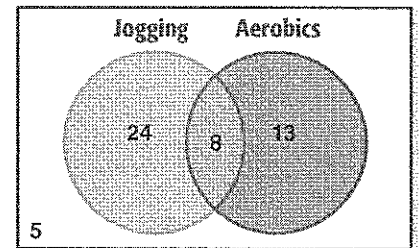
	Males	Females
Animal Shelter	26	21
Hospital	13	17
Library	9	14



Real-World Link

A total of 63.4 million volunteers contributed 8.1 billion hours of service in 2009.

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				Total
		Black	Brown	Red	Blond	
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

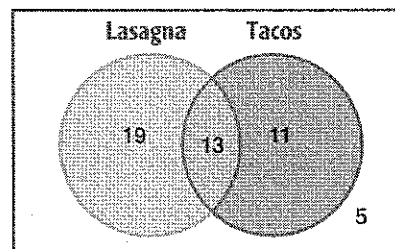
14. The two-way table below shows the number of hours students studied and whether they studied independently or with a study group.

	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. **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.



Name _____ Date _____ Period _____

8th Grade Math **Creating & Converting Two Way Tables** 8.SP.4

1. Mr Smith splits pupils that did not do their homework into two categories: First time offenders and repeat offenders.
 - a) Design a table that he could use to show how many boys and how many girls did not do their homework.

 - b) In one month 36 girls and 12 boys did not do their homework for the first time. Twelve girls and 30 boys did not do their homework again. Put these figures in your table and find the totals.
 - c) Convert your two-way frequency table into a relative frequency table.

2. Frank is trying to decide on players for a soccer team for a big competition. He decides to look at the strike rate for three of his attackers.
 - a) Design a table for Frank, showing the number of goals made and not made for three players: Cole, Rooney and Henri.

 - b) Cole has scored 5 goals in 7 attempts, Rooney has scored 3 goals in 5 attempts, and Henri has scored 4 goals in 9 attempts. Put these values in your table.
 - c) Convert your two-way frequency table into a relative frequency table.

 - d) If you were Frank who would be your 1st choice striker?

3. Heather the hairdresser is making a record of all the customers she has had in the last month.
- Design a table that will show the number of male and female customers who are blond or brunette.
 - In one month she has 40 blond females out of 60 total females and only 5 blond males. She had 34 total brunettes. Put these values in the table and complete the missing values.
 - Convert your two-way frequency table into a relative frequency table.
4. Steven is worried about how much trash he creates each week. He decides to look at how many items he could recycle over 3 weeks which he ends up throwing in the normal trash bin.
- Design Steven a table to show for the number of cans, glass bottles and newspapers he throws away over the next 3 weeks.
 - Steven throws away 5 cans in the 1st week, 3 in the second and 4 in the last week. He throws away 6 glass bottles every week and 1 newspaper in the last week. In the 1st two weeks he throws away 2 and then 3 newspapers. Put these numbers in your table.
 - Why is the table such a good way to show this sort of information?
 - Convert your two-way frequency table into a relative frequency table.