

# Venn Diagrams and Percents

## A Lesson for Grades 6–8

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### Materials

- Newsprint and markers for each student

## Overview of Lesson

Annette Raphel is a recipient of the Presidential Award for Excellence in Mathematics and Science Teaching. She is the author of *Math Homework That Counts*, a resource for teachers of grades 4–6. Annette taught this percent lesson to middle school students at Milton Academy in Massachusetts. In this activity, important concepts about percent come up in a context that matters to students—themselves. The lesson has the added bonus of serving as a wonderful community builder.

The lesson below includes Annette’s account of what transpired when she taught the lesson.

## Lesson Outline

### Focus or Warm-Up

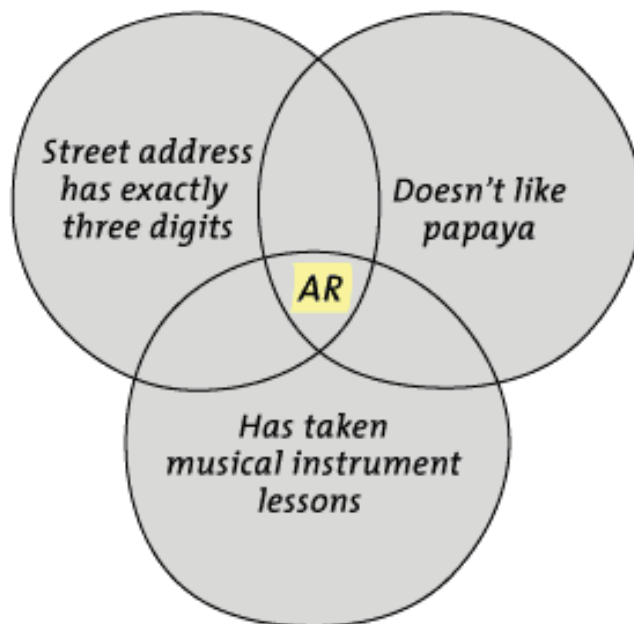
1. Draw a large Venn diagram on the board and label each of the three intersecting circles: *Has taken musical instrument lessons*, *Doesn’t like papaya*, and *Street address has exactly three digits*.

In my class, the students’ interest piqued when I wrote my initials on a 1-by-2-inch sticky note and placed it in the intersection of all three circles. I explained, “Each circle describes something that’s true about me, so I put my initials in the intersection. That’s the only place on this Venn diagram that’s inside each of the three sets.” My explanation reviewed terminology about Venn diagrams.

“What three things do you now know about me?” I asked.



“You play an instrument, you don’t like papaya, and your street address has three numbers in it,” Rose said.



2. Make some guesses about your class and write them as percents on the board. Then ask students to determine the percent for another guess. For example, I told my students, “Now I’m going to make some guesses about our class.” I wrote on the board:

*45% play musical instruments*

*25% don't like papaya*

*33% live at addresses with exactly three digits*

“Also,” I continued, “I think only one other person in the class belongs in the center with me. Since there are twenty-five of us altogether, what percent do I predict will be in the intersection?”

Jason said, loudly and confidently, “Each person is worth four percent because there are twenty-five fours in one hundred.”

“Two people would be eight percent,” Lauren added. I wrote on the board:

*8% will be in the intersection of the three sets*

## Introduction

3. Give each student a sticky note and ask each to write his or her initials on it.
4. Ask a student to go up to the board and place his or her sticky note on the Venn diagram.

“I’m kind of confused,” Maryann told me. “I take music lessons and my address has exactly three digits, but I don’t know if I like papaya. I think I need another sticky.”



Aaron had a thought. “Since you don’t know whether you like papaya or not, you just need to be in the circles that say you live in a house with three numbers and that you take music lessons.” He came up and helped Maryann place her sticky note.

“Is there anyone who doesn’t belong in any of the circles?” I asked. Jeffrey raised his hand.

“So, should Jeffrey throw out his sticky note?” I asked.

“He’s still part of the class,” Lauren commented.

“I think I go outside,” said Jeffrey as he went up and placed his sticky outside of the three circles. I nodded my agreement.

I then placed my finger in the section that was inside the circle labeled “Street address has exactly three digits” but not in any other set.

“What’s true about someone who would put his or her sticky right here?” I asked. Louise correctly identified that the person would have a street address with three digits.

“What else do you know about that person?” I asked.

Everyone thought for a moment. Then Louise piped up, “They like papaya and they don’t play an instrument.”

I then said, “Now you’ll all place your sticky notes where they belong. If you’re not sure, consult with a friend.” I had the students come up to the chalkboard in small groups. Some children knew exactly where to place their sticky notes, and others were hesitant. But animated conversation helped each student decide.

5. After all of the students have posted their initials, count the sticky notes to verify that every student has posted one. Allow a minute for silent inspection of the results. Then tally the information and record it on the board. The information in my class was as follows:

*15 have taken music lessons*

*9 have addresses with exactly three digits*

*5 dislike papaya*



6. Now invite students to figure out what percent of the class fits each category.

“Let’s figure out what percent of our class actually fits each category,” I told my class. “Don’t reach for your calculators—I’d like us to figure these out in our heads.” Calculators were available to students at all times, so this wasn’t a typical direction. However, I wanted the students to reason mentally and talk about their thinking. I felt the discussion would help students who weren’t as confident. To help, I wrote on the board what Jason had already said:

$$1 \text{ person} = 4 \text{ percent}$$

I asked, “How many people would represent fifty percent?”

“Twelve and a half,” Lauren said thoughtfully, “but you can’t have a half a person, so I guess we can’t have exactly fifty percent in any category.”

“We can’t have ten percent either,” Tom said. “Nope, that would be two and a half people.”

“Let’s see how well I did with my guesses,” I said. “Fifteen out of twenty-five of us take music lessons. Is it more than fifty percent or less than fifty percent?” The benchmark of one-half is useful for calculating exact percentages.

“It’s more than half, but not so far away,” Paul said. “I think it’s sixty percent.”

“How do you know?” I asked.

Paul answered, “I know that fifteen–twenty-fifths can be reduced to three-fifths, and I know that each fifth is twenty percent. So I needed three twenty percents.”

Isaac joined in. “I just multiplied fifteen by four since I knew that each person is worth four percent,” he said.

Tom added, “I know that one hundred percent of the people would be twenty-five, so ten people, or forty percent, are not in the circle. Sixty percent are.”

“Well, how did I do?” I asked.

“Not so good,” Alan said. “You guessed less than half of us and it was more than half.”

Sarah countered, “But she was only fifteen percent off.”

“Fifteen percent is practically four people off,” David said, “and in a class of twenty-five, that’s not too bad.”

We then figured out that 36 percent lived at three-digit addresses and 20 percent disliked papaya.



## Exploration and Summary

7. Next distribute newsprint and markers and ask the students to draw Venn diagrams with three intersecting circles, label each circle, and guess how many of the students would fall into each category.
8. At the end of class, collect the students' papers.
9. The following day, redistribute the papers and have every student sign in on everybody else's Venn diagram. Then have students calculate the percentages of people who fit each category. There will most likely be a great deal of collaboration, and the class discussion that follows will be rich and productive.

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