Venn Diagrams & Survey Notation

Set Theory & Survey Problems Worksheet · Grade 7–9

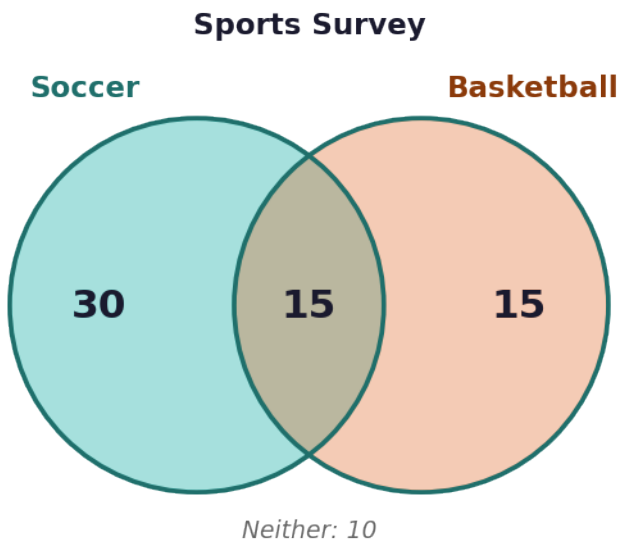
Name: _____ Date: _____

Learning Objectives

- Interpret Venn diagrams with two sets to identify regions including intersection, union, and complement
- Apply set notation (union, intersection, complement) to solve real-world survey problems
- Calculate cardinalities of sets and subsets using given Venn diagram data

Problems

1. A survey of students found that 45 like soccer, 30 like basketball, 15 like both, and 10 like neither. Use the Venn diagram below to identify how many students are ONLY in the soccer region (not basketball).



2. Using the same survey (45 like soccer, 30 like basketball, 15 like both, 10 like neither), how many students were surveyed in total? This is the cardinality of the universal set.

$$|U| = |A \text{ only}| + |B \text{ only}| + |A \cap B| + |\text{neither}|$$

3. In a school survey, Set A is students who want to donate blood and Set B is students who want to serve breakfast. The Venn diagram shows 370 only in A, 120 in both, and 210 only in B, with 290 in neither. Find the cardinality of Set A.

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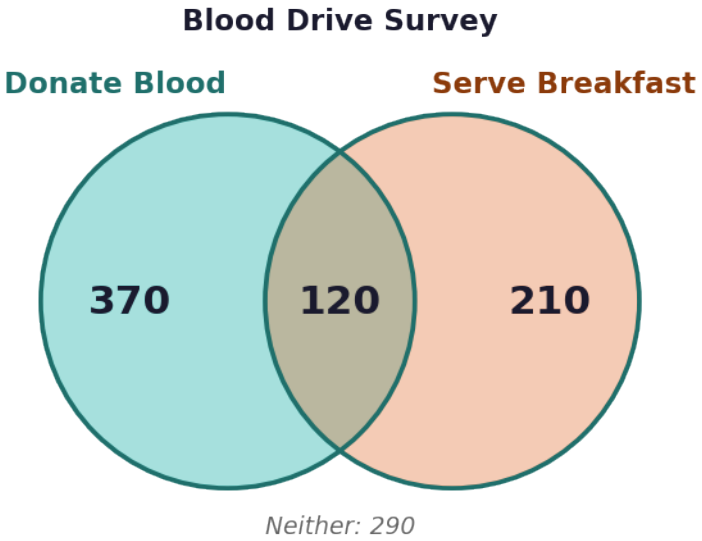
$$|A| = |A \text{ only}| + |A \cap B|$$

4. Using the blood drive survey (370 only donate blood, 120 do both, 210 only serve breakfast, 290 neither), find the number of students willing to serve breakfast. This is the cardinality of Set B.

$$|B| = |B \text{ only}| + |A \cap B|$$

5. A Venn diagram shows the blood drive survey below. How many students are willing to donate blood but NOT serve breakfast? Write the set notation for this region.



6. Using the blood drive Venn diagram (370 only donate, 120 both, 210 only serve, 290 neither), how many students were surveyed in total? Then find the cardinality of the union of A and B.

$$|A \cup B| = |A| + |B| - |A \cap B|$$

7. In a class survey, 60 students were asked if they like math or science. 25 like only math, 18 like only science, 12 like both, and the rest like neither. Using set notation, find the complement of (A union B), which represents those who like neither subject.

$$|(A \cup B)'| = |U| - |A \cup B|$$

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8. A survey asks 500 high school students about two volunteer tasks. Set A (clean the park) has 280 students, Set B (plant trees) has 195 students, and 85 are willing to do both. How many students are willing to do at least one task? How many are willing to do neither?

$$|A \cup B| = |A| + |B| - |A \cap B|$$

9. A Venn diagram for a community survey has Set A (recycle at home) and Set B (compost food waste). There are 415 in A only, 160 in both, 245 in B only, and 180 in neither. A resident is chosen at random from those who recycle. What fraction of all surveyed residents recycle at home (Set A)?

$$\frac{|A|}{|U|}$$

10. A school of 800 students is surveyed about two extracurricular clubs: drama (Set A) and debate (Set B). The number who joined drama is three times the number who joined only debate. 95 students joined both clubs. 310 students joined neither club. The number who joined only drama is 220. Using this information, find: (a) the number in only debate, (b) the total in Set B (debate), and (c) verify the total adds up to 800.

$$|U| = |A \text{ only}| + |B \text{ only}| + |A \cap B| + |\text{neither}|$$

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Venn Diagrams & Survey Notation — Answer Key

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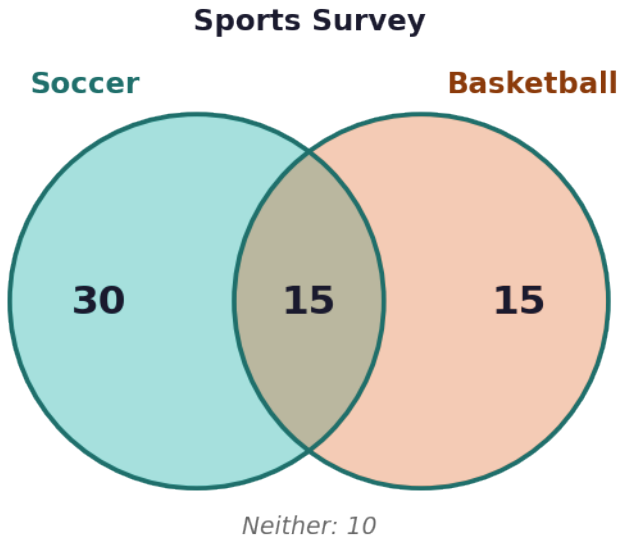
Answer Key

1. Answer: 30 students



- The 'only soccer' region excludes those who also like basketball.
- Only Soccer = Total Soccer – Both = 45 – 15 = 30 students.

2. Answer: 70 students

- Only A = 45 – 15 = 30; Only B = 30 – 15 = 15; Both = 15; Neither = 10.
- |U| = 30 + 15 + 15 + 10 = 70 students.

3. Answer: 490 students

- Set A includes students willing to donate blood only AND those willing to do both.
- |A| = 370 + 120 = 490 students.

4. Answer: 330 students

- Set B includes students who only serve breakfast AND those who do both.
- |B| = 210 + 120 = 330 students.

5. Answer: 370 students; notation: A ∩ B'

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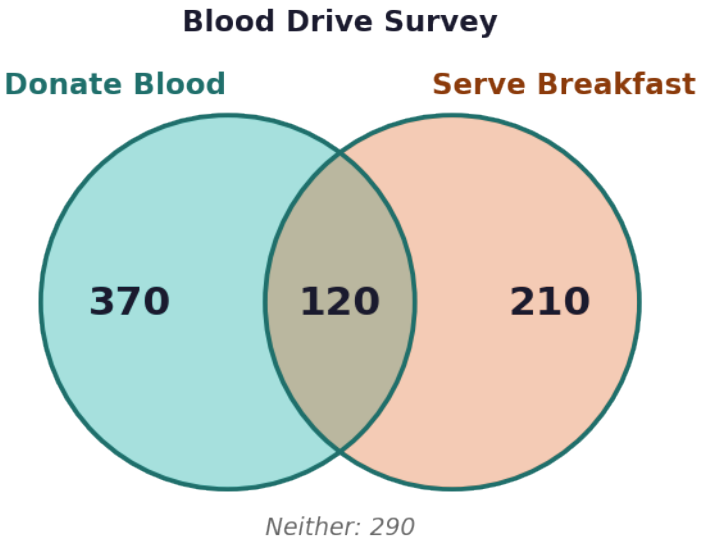

- We want students in Set A who are NOT in Set B, which is the complement of B intersected with A.
- This is the 'only A' region = 370 students, written as A ∩ B'.

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6. Answer: Total = 990; |A ∪ B| = 700

- |A| = 370 + 120 = 490; |B| = 210 + 120 = 330.
- |A ∪ B| = 490 + 330 – 120 = 700.
- Total |U| = 700 + 290 (neither) = 990 students.

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7. Answer: 5 students

- |A ∪ B| = 25 + 18 + 12 = 55.
- |(A ∪ B)'| = 60 – 55 = 5 students like neither math nor science.

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8. Answer: At least one: 390; Neither: 110

- |A ∪ B| = 280 + 195 – 85 = 390 students are willing to do at least one task.
- Neither = 500 – 390 = 110 students.

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9. Answer: 575/1000 or 23/40

- |A| = 415 + 160 = 575.
- |U| = 415 + 160 + 245 + 180 = 1000.
- Fraction = 575/1000 = 23/40.

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10. Answer: (a) 175; (b) 270; (c) 220 + 175 + 95 + 310 = 800 ✓

- Only A = 220, Both = 95, Neither = 310.
- Only B = 800 – 220 – 95 – 310 = 175 students joined only debate.
- |B| = Only B + Both = 175 + 95 = 270 students in debate total.
- Verify: 220 + 175 + 95 + 310 = 800 ✓

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