

Introduction to Set Theory and Logic

General Outcome: Develop critical thinking skills related to uncertainty.

SO1. Analyze puzzles and games that involve numerical and logical reasoning, using problem-solving strategies. [CN, ME, PS, R]

puzzles such as chess, Sudoku, Nim, logic puzzles, magic squares, Kakuro and cribbage.)

1.1 Determine, explain and verify a strategy to solve a puzzle or to win a game; e.g.,

- guess and check
- look for a pattern
- make a systematic list draw or model
- eliminate possibilities
- simplify the original problem
- work backward
- develop alternative approaches.

1.2 Identify and correct errors in a solution to a puzzle or in a strategy for winning a game.

1.3 Create a variation on a puzzle or a game, and describe a strategy for solving the puzzle or winning the game.

SO2. Solve problems that involve the application of set theory. [CN, PS, R, V]

2.1 Provide examples of the empty set, disjoint sets, subsets and universal sets in context, and explain the reasoning.

2.2 Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning.

2.3 Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation.

2.4 Determine the elements in the complement, the intersection or the union of two sets.

2.5 Explain how set theory is used in applications such as Internet searches, database queries, data analysis, games and puzzles.

2.6 Identify and correct errors in a solution to a problem that involves sets.

2.7 Solve a contextual problem that involves sets, and record the solution, using set notation.

Mathematical Processes

- **Connections [CN]** Students are expected to make *connections* among mathematical ideas, other concepts in mathematics, everyday experiences and other disciplines
- **Problem Solving [PS]** Students are expected to develop and apply new mathematical knowledge through *problem solving*
- **Reasoning [R]** Students are expected to develop mathematical reasoning
- **Visualization [V]** Students are expected to develop *visualization* skills to assist in processing information, making connections and solving problems.
- **Mental Estimation [ME]** Students are expected to demonstrate fluency with mental mathematics and estimation.

Lesson 1: Types of Sets and Set Notation

Achievement Indicators

2.1 Provide examples of the empty set, disjoint sets, subsets and universal sets in context, and explain the reasoning.

2.2 Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning.

2.3 Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation.

2.4 Determine the elements in the complement, the intersection or the union of two sets.

2.7 Solve a contextual problem that involves sets, and record the solution, using set notation.

Discovery Based Learning Ideas:

1. [Sets and Venn Diagram \(Applet\)](#) - (Interactivate) [T]

This interactive helps students understand the terms surrounding the ideas of sets and Venn Diagrams. It also helps them understand how to arrange items in a Venn diagram.

Lesson Links:

- [Click here](#) for ERLC Lesson Link (pdf). Please use this lesson as a framework for your own teaching environment.

Assessment For Learning Ideas:

1. **Venn Research [CN]** -- Have students find Venn Diagrams in the newspapers or internet. Once they find an example, have them create questions that include the terminology empty set, disjoint sets, subsets, and universal sets. Have them provide an answer key to those questions.

Additional Resources:

- [Click here](#) for More math notes on an Introduction to Sets (**Tools4Teachers**)

Lesson 2: Exploring Relationships between Sets

Achievement Indicators

2.2 Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning. [V]
[R]

2.3 Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation. [V] [C]

2.7 Solve a contextual problem that involves sets, and record the solution, using set notation.

Discovery Based Learning Ideas:

1. Operations on Sets

- [Operations on Sets](#) from the [Wolfram Demonstrations Pr](#)
- [Click here](#) to download a student assessed exploration that can be used with this applet.

Lesson Links:

- [Click here](#) for ERLC Lesson Link (**Notebook**). Please use this lesson as a framework for your own teaching environment

Assessment For Learning

1. **Student Created Assessment [CN], [V]** -- Have students think of two sets that will have some overlap and create a Venn Diagram. If students have trouble thinking of an idea, direct them to Explore the Math on page 19. Have the students describe the four areas of the Venn diagram using the Venn Diagram they created.

Additional Resources to Support this Lesson

- [Click here](#) for more notes Venn Diagrams (**Purple Math**)
- [Click here](#) for some work sheets on Venn Diagrams (**Enchanted Learning**)
- [Click here](#) for an interactive for creating easy Venn Diagrams (**Applet**)
- [Click here](#) for some practice problems on Venn Diagrams (**NLVM**)
- [Click here](#) for an interactive for finding the shaded regions of two or three intersecting Venn Diagrams (**Wolfram**)

Videos:

- for a General video for this lesson ([Youtube Link](#))
- for a video on Introduction to Venn Diagrams ([YouTube Link](#))
- for a video on Solving problems using Venn Diagrams ([Youtube Link](#))
- for a video on Venn Diagrams: [Shading Regions with Three Sets, Part 2 of 2](#)

Lesson 3: Intersection and Union of Two Sets

Achievement Indicators:

- 2.2 Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning.
- 2.3 Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation.
- 2.4 Determine the elements in the complement, the intersection or the union of two sets.
- 2.5 Explain how set theory is used in applications such as Internet searches, database queries, data analysis, games and puzzles.
- 2.6 Identify and correct errors in a solution to a problem that involves sets.
- 2.7 Solve a contextual problem that involves sets, and record the solution, using set notation.

Discovery Based Learning:

1. [Click here](#) for an interactive that shows a basic example of two sets that must intersect -- Basketball and Volleyball. (Tools4Teachers) You will need to have an account with **Tools4teachers** to access this interactive.

Lesson Links:

- [Click here](#) for ERLC Lesson Link. **(Notebook)** Please use this lesson as a framework for your own teaching environment.

Assessment For Learning

1. [Set Theory Worksheet](#) -- Chang (Word document). This worksheet is a great way for students to be creative and get a true understanding of sets and set notation. **[V], [CN] (Standard of Excellence)**
2. [Virtual 3-set Venn Diagram Manipulative \(Standard of Excellence\)](#) -- This is a nice tool to practice set notation and shading corresponding areas of the venn diagram.
3. **Exit Slip Questions**
 - Have students draw Venn diagrams for $P \cap Q$, $P \cap Q'$, $P' \cup Q$, $P' \cup Q'$. **[V] (Acceptable Standard)**
 - Venn diagrams are useful when three subsets are given. Construct such a diagram, given the subsets P , Q , and R . Identify each of the eight resulting areas in terms of P , Q , and R . Use the appropriate set theory symbols. **[V, R] (Standard of Excellence)**

Videos:

- General video for this lesson ([Youtube Link](#))
- [Sets: Union and Intersection](#)

Lesson 4: Applications of Set Theory

Achievement Indicators

2.5 Explain how set theory is used in applications such as Internet searches, database queries, data analysis, games and puzzles.

2.6 Identify and correct errors in a solution to a problem that involves sets.

2.7 Solve a contextual problem that involves sets, and record the solution, using set notation.

Lesson Links:

- [Click here](#) for ERLC Lesson Link (**Notebook**). Please use this lesson as a framework for your own teaching environment.

Videos:

- General video for this lesson ([Youtube Link](#))

Unit Notes Shared by Colleagues

In this section are complete unit lessons shared by colleagues:

1. [Click here](#) to download Notebook Lesson shared by Boulanger
2. [Click here](#) to download Word Document of the Student notes that go with the Notebook Lessons shared by Boulanger