1.7 Analyzing Puzzles and Games

This outcome is intended to be integrated throughout the course by using puzzles and games focused on sliding, rotation, construction and deconstruction. They are intended to help enhance spatial reasoning and problem-solving strategies. Numerical reasoning and logical reasoning using puzzles and games will be addressed in Mathematics 3201.

Students need time to play and enjoy the game before analysis begins. They can then discuss the game, determine the winning strategies and explain these strategies by demonstration, orally or in writing.

A variety of puzzles and games, such as board games, online puzzles and games, appropriate selections for gaming systems and pencil and paper games should be used. The puzzles and games may relate directly to other outcomes in this course, but the main purpose is to develop spatial reasoning.

It is not intended that the activities be taught in a block of time, but rather explored periodically during the year.

Games give students a chance to develop positive attitudes towards mathematics by reducing the fear of failure and error. Games provide students with an opportunity to interact with other students, to explore intuitive ideas and problem-solving strategies. Students' thinking often becomes apparent through the actions and decisions they make during a game, so teachers have the opportunity to formatively assess learning in a non-threatening situation.

Problem-solving strategies will vary depending on the puzzle or game. Some students will explain their strategy by working backwards, looking for a pattern, using guess and check, or by eliminating possibilities, while others will plot their moves by trying to anticipate their opponents' moves. As students play games and analyze strategies, they explore mathematical ideas and compare different strategies for efficiency.

Consider the following peg game. The goal of the puzzle is to switch the pegs on the left with the pegs on the right by moving one peg at a time. A peg may only be moved to an open slot directly in front of it or by jumping over a peg to an open slot on the other side of it. You may not move backwards. The game ends when you win or get stuck.
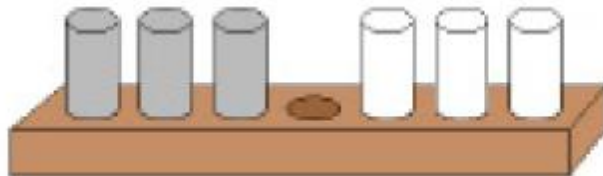
1. What did you like about the game? Why?

2. What did you notice while playing?

3. What was your first move?

4. What were your first three moves?

5. What problems arose when solving the puzzle?

6. What are the minimum number of moves to win this game?

7. Did you anticipate the next move?

8. Did you notice any patterns?

Ask students to participate in the following activities. They should discuss the strategies used and identify any challenges that occurred while trying to solve the puzzle.
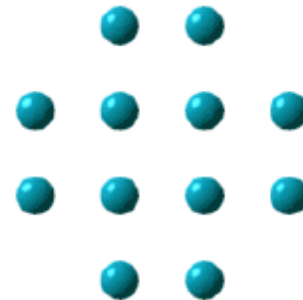
Example 1:
Move 3 matchsticks to make three identical squares.
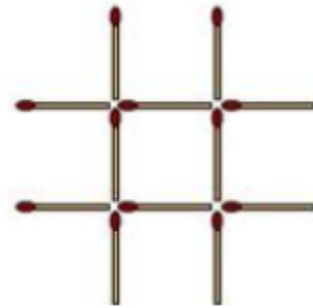
Example 2:
How many squares can you create in this figure by connecting any 4 dots.

Example 3:
Take eight pennies and arrange them in row. The goal is to end up with four piles of two pennies each. Each move consists of picking up a penny, jumping in either direction over two "piles" and landing on the third. Each pile may consist of a single coin or two coins. This must be done in four moves. Discuss the strategy used to solve the puzzle.


Goal:
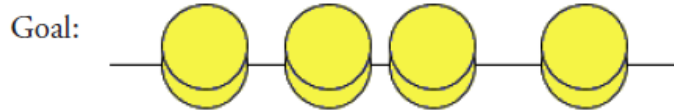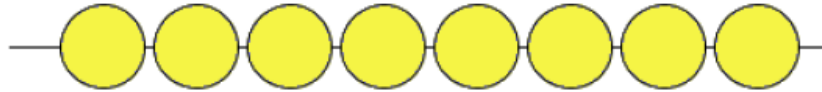
Example 4:
The clues in this type of problem are non-verbal. In this activity, the squares are cut up by the teacher and each member of a group-of-four is given three pieces marked with the same letter. Ask the group to make four complete squares.
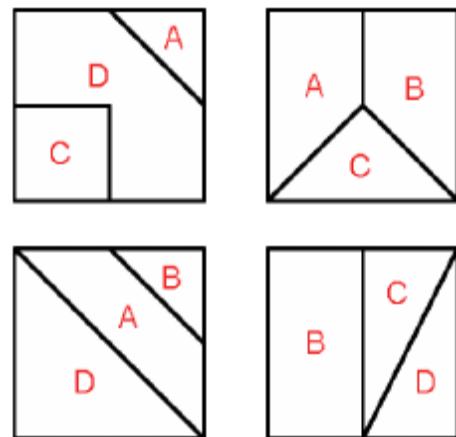
An example of a board game that resembles Tic-Tac-Toe is Pong Hau K'i, which is also played by two players. The game board is made up of five circles joined by seven line segments. You will need to draw a game board. Each player will have two stones, counters or buttons, of different colours. Place two red stones at the top, for example, and two blue at the bottom as shown below.
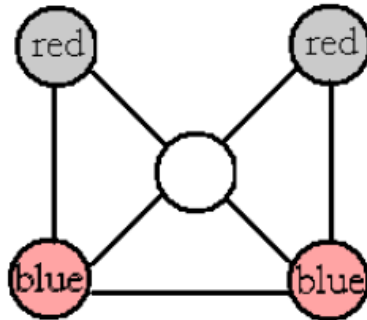
Players take turns sliding one stone along a line to an adjacent empty circle. To win, you have to block the other player so that he or she cannot move.

You should play the game several times, taking turns making the first move. Answer the following questions as they play the game:

1.   Where will the first move always be?

2.   What does the board look like when one player is blocked? Why will this help the player?

3.   Is it better to have the red stones or blue stones?

4.   Is it better to make the first move or second move?

5.   Is anticipating the possible moves ahead an effective game plan strategy? Explain why or why not.

A variation of this game is to start from different positions. Decide which colour each player will use and who will place the first stone. After the first stone is placed on any circle, the other player places a stone on any of the four remaining circles and so on until all four stones are on the board. The game is continued by moving the pieces as previously decribed. Modified game several times.

6.   Is it more challenging than the original game?

Example 5:
Take nine pennies and arrange them in a 3 by 3 grid. There are now eight straight lines that each pass through three pennies: three horizontal, three vertical and two diagonal. Your goal is to move exactly two pennies so that there are ten straight lines, each with three pennies. In the solution, there are no straight lines with more than three pennies, and no penny is placed on top of another.
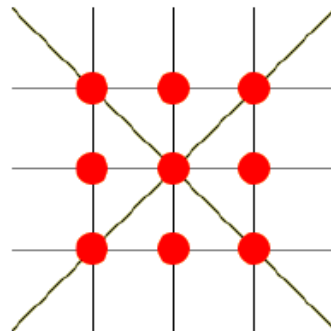
Textbook Questions: page 55 - 57 #1 – 15. Try whichever games you like. Have fun!