

# MATH GAMES IN THE JUNIOR GRADES

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## Importance of Games in a Junior Math Program:

- Intentionally and carefully developed educational math games can contribute to improving students' knowledge of math concepts (Wiburg, Chamberlin, Valdez, Trujillo, & Stanford, 2016).
- to increase students' interest, curiosity, attentiveness, engagement and motivation in math (Rai & Beck 2012).
- Games encourage students to plan, take initiative, prioritize, sequence, as well as helps students sustain their focus; executive functioning skills that are beneficial for future successes in school and careers (Schlosser & Balzano, 2014).
- Playing games in math results in positive student attitudes towards math, as well as increased math fluency (Schlosser & Balzano, 2014).

## Types of Games Used in the Junior Grades:

- We explore 2 types of math games in our workshop:
  - 1) Teacher-Mediated Games
    - This category includes teacher-modified board games and teacher-created math games.
  - 2) Technological Games
    - This category includes math-based computer games and apps.

## How Games Fit Into a Junior Math Program:

Games can be used to supplement learning as students apply explicitly taught concepts.

- offered as an independent math center activity while the teacher is with a guided math group.

Math games provide opportunities for differentiation:

- According to the Ontario Mathematics curriculum it is important that teachers provide ways for students to learn using a variety of methods, including independently, cooperatively, and through hands-on experiences (pg. 24).
- Math games can be used individually, in small groups, or classwide, thus helping teachers provide ways for students to learn using a variety of methods.

## Assessing the Effectiveness of Games in the Junior Grades

### Teacher-Mediated Math Games Criteria

- Games should be played cooperatively and competitively (Burns, 2009)
  - Cooperative games foster communication and community
  - Competitive games encourage risk-taking, losing fairly, and evaluates skills
- Games should use both reasoning and chance (Burns, 2009)
  - Math becomes accessible for all learners
  - Student's practice math skills and develop their problem-solving, reasoning, and critical thinking
- Games should be taught to the whole class at the time to avoid confusion and reduce classroom management (Burns, 2009)
- Games should allow teachers to ask enriching questions throughout the game playing process (Simpson, 2016)
- Games should not completely reliant on speed or memorization (Hildebrandt, 1998)
- Games should allow multiple skills to be tested (Hildebrandt, 1998)

### Technological Math Game Criteria

- Pedagogical Fidelity
  - How well does this tool allow the students to do math?
- Mathematical Fidelity
  - How well does the tool represent underlying mathematical properties with accuracy?
- Cognitive Fidelity
  - How does the tool reflect mathematical thinking processes rather than just arriving at answers?

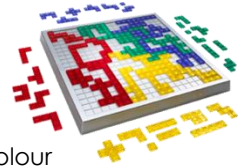
(Shin, Smith, & Kim, 2018)

# Game Resources

## Strand: Geometry and Spatial Sense

### Blokus (Maida & Maida, 2011)

- Students are challenged to use as many of the 21 pentominoes pieces to cover the game board
- Each player places any piece to cover a corner of the game board
- Players take turns placing one piece at a time following three rules:
  - Each new piece placed on the board must touch at least one other vertices of the same colour
  - No sides of the same colour can touch
  - There are no restrictions on how different coloured pieces can touch one another
- When no players can move, count the total number of squares on the board and subtract that from the number of unused squares you have. If you placed all 21 squares you get 15 points. Player with the highest amount of points wins.



### Curriculum Expectations:

#### Grade 5

- *Location and Movement Identify, perform, and describe translations using a variety of tools*
- *Location and Movement: Create and analyze designs by translating and/or reflecting a shape, or shapes, using a variety of tools*

#### Grade 6

- *Location and Movement: Identify, perform, and describe, through investigation, rotations of 180 degrees and clockwise and counter clockwise rotations of 90 degrees, with the center of rotation inside or outside the shape*

### Pentomino Battleship (adapted from - Robertson Program)

<https://wordpress.oise.utoronto.ca/robertson/portfolio-item/pentomino-battleship/>

- Game Objective: To 'sink' your opponent's pentomino battleship. Every student has a pentomino set, two different coloured tiles, and has two grids (labelled with number and letters.)
- The students are in pairs, facing each other with a barrier in between. Each player has two grids each
- On one grid, the student places two pentominoes down. On the other grid the student records the results of playing battleship. Players take turns calling out letter-number combinations. If they hit a part of the battleship, they get another turn. They record their results on the second grid using the two different coloured tiles, one colour for hits and one colour for no hits. This happens until one child's battleships are sunk.

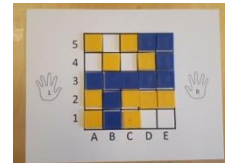
### Curriculum Expectations:

#### Grade 4

- *Identify and describe the general location of an object using a grid system*

#### Grade 5:

- *Compare grid systems commonly used on maps (i.e., the use of numbers and letters to identify an area; the use of a coordinate system based on the cardinal directions to describe a specific location*



### Tetris (Newcombe, 2010)

- Students rotate shapes to fit them together in the best possible way as the shapes fall down the screen.
- Playing Tetris has been shown to have long-term and transferrable effects on improving spatial skills (Newcombe, 2010).
- It has been shown to contribute to the growth of spatial skills in people with spatial abilities ranging from low to high (Newcombe, 2010).
- De Lisi & Wolford (2002) 's grade 3 study on Tetris found it helped increase student's mental rotation performance abilities, as well as improved performance on paper and pencil mental rotation task.

### Curriculum Expectations:

#### Grade 4

- *Location and Movement: Identify, perform, and describe reflections using a variety of tools (eg. Technology)*

#### Grade 5

- *Location and Movement: Identify, perform, and describe translations using a variety of tools (eg. Technology)*
- *Location and Movement: Create and analyze designs by translating and/or reflecting a shape, or shapes, using a variety of tools*

#### Grade 6

- *Location and Movement: Identify, perform, and describe, through investigation, rotations of 180 degrees and clockwise and counter clockwise rotations of 90 degrees, with the center of rotation inside or outside the shape*
- *Location and Movement: Create and analyze designs made by reflecting, translating, and/or rotating a shape by 90 or 180 degrees*

