UBC Geering Up
Engineering Outreach

Math Games and Puzzles

Subject: Math	**Grade:** 3-12	**Duration:** 1-3 hours
Lesson Overview	Students will engage in a variety of math games and puzzles either individually or in groups to practice creative and critical thinking skills in math.	

Curriculum Ties (in addition to satisfying multiple core competencies):

Math Core Competencies:

Communication:

- Collaborating: Students may work in groups/teams to complete the games and puzzles. Emphasis will be on valuing others' perspectives, strategies, and efforts.

Thinking:

- Creative Thinking: Students will be encouraged to think "outside the box" to generate innovative ideas in addition to working collaboratively with ideas from others.
- Critical and Reflective Thinking: Students will think critically and reflectively and will be able to question and challenge their own thoughts, ideas, and assumptions and challenge those of others.

Personal & Social:

- Personal Awareness and Responsibility: Students will be brainstorming and problem solving with their peers in a constructive and respectful way.

Math Curricular Competencies: *

Reasoning and modelling:

- Use logic and patterns to solve puzzles and play games
- Use reasoning and logic to explore, analyze, and apply mathematical ideas
- Estimate reasonably
- Demonstrate and apply mental math strategies

Understanding and solving

- Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, inquiry, and problem solving
- Apply flexible and strategic approaches to solve problems
- Solve problems with persistence and a positive disposition

Communicating and representing

- Explain and justify mathematical ideas and decisions in many ways
- Represent mathematical ideas in concrete, pictorial, and symbolic forms
- Use mathematical vocabulary and language to contribute to discussions in the classroom
- Take risks when offering ideas in classroom discourse

Connecting and reflecting

- Reflect on mathematical thinking
- Connect mathematical concepts with each other, other areas, and personal interests
- Use mistakes as opportunities to advance learning

*Note: These competencies have been pulled from the grade 7 curriculum specifically, however similar competencies can be found throughout the grade range of 4-12.

Content Objectives

- Have students work individually or in teams to solve math puzzles or play math games.
- Have students think strategically and to reflect on their mistakes and successes after completion of the activity.

Materials & Equipment Needed

Consumables:	Non-Consumables:
• Blank paper • Instruction worksheets and game grids • If building puzzles from scratch -> Craft supplies (e.g. Construction paper, cardboard, glue, etc.)	• Pencils and multicolour pens/markers • If building puzzles from scratch -> Craft supplies (e.g. scissors, rulers, etc.)

Lesson & Activity

Lesson Stages	**Learning Activities**

Introduction	**Prepare**
	• Decide which games and puzzles to include
	  ○ For younger kids, introduce fewer or only one game at a time
	  ○ Some puzzles (like river crossing puzzles) work best with a visual with pieces that can be moved so that students can simulate the problem/solution
	• Suggested resources for puzzles:
	  ○ Mathfair.com
	  ○ Math Games with Bad Drawings by Ben Orlin
	• Print out worksheet and game instructions, ensure there are enough so that students can read them without crowding
	• Play test each game/puzzle so that you are comfortable with the rules and solution

	Introduce the games and puzzles • Give a brief overview of what games and puzzles are available • For younger kids: discuss sportsmanship and game etiquette when winning/loosing • Give time frame for play • If asking students to complete a reflection or other assessment piece at the end, perhaps suggest a few guiding questions they can think about as they play
Activity	**Play** • Let students play! • Be on hand to offer rule clarifications or arbitrate disputes as needed

Closure	**Review**
	• Have a class discussion about what math concepts and skills were practiced in this activity
	• Ask students to reflect on the puzzles and games
	  ○ How do the games reflect what they have learned in class?
	  ○ What skills and strategies did they use?
	  ○ How did they feel and act when they won/lost?
	  ○ Were they able to work collaboratively?

Step Ups & Step Downs	**Step Up** • Provide more games and harder games • Ask students to write/explain specific math concepts used in the games • For older students: ask students to research and find their own games/puzzles and to create a poster and game set. Students can display their game in a math fair style presentation to other

	classes. Ask students for an explanation of math concepts used in their chosen game. **Step Down** • Provide fewer games or have the whole class play the same game at the same time • Have more adults present to explain rules and oversee play

Additional Resources

Below are examples of basic print outs with instructions to a selection of math games and puzzles. These are no means all of the games available, please check out the resources linked above for more ideas.

Soko Puzzles

Goal

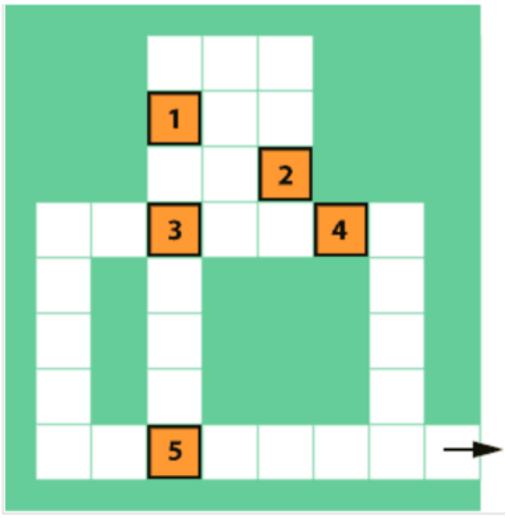
You are in a warehouse full of crates and a maze of empty aisles. Certain crates are labeled with numbers. Your goal is to move these numbered crates out of the warehouse

Rules

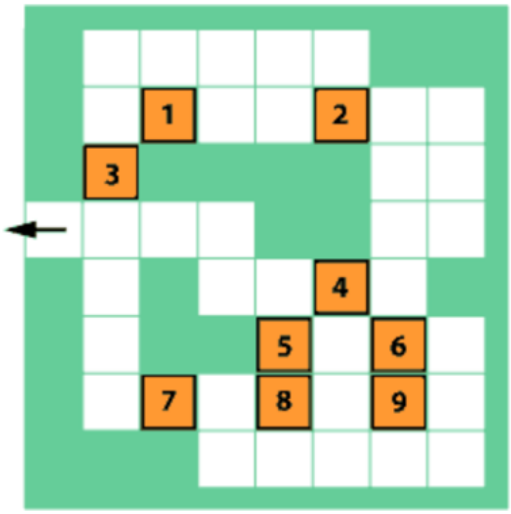
1. You enter the warehouse as a person at the entrance; you must walk around the warehouse and push the labeled crates out of the warehouse. You may not walk through walls or crates.
2. To push a box, you must get behind it and push it forward into an empty space in the aisles, along a row or a column.
    a. Therefore, once a box is in a corner, it will be stuck there.
3. Crates must stay within the free paths (shown as empty squares) and can't go through walls or other crates.

Try to get as many crates out of the warehouse as you can. The order they are removed from the warehouse does not matter.

Puzzle 1



Puzzle 2



Countdown

Go to: https://mathsbot.com/puzzles/countdown

Rules

1. Each player must use pen and paper to write down their work. If it's not on paper, it doesn't count!
2. At the start of each round, set a timer for 1 or 2 minutes. In that time, each player must try and use the 6 numbers provided to make the target number.
   a. You may use addition, subtraction, multiplication, division, and brackets.
   b. You do not need to use all the numbers.
3. At the end of the round players compare their answer to the target number. Your score is your distance from the number (i.e. lower scores are better). Max score in a round is 10.
4. Reset the numbers and target for each round. Play 3-5 rounds and then compare scores, lowest score wins!

Example

Variations & Notes:

- Require all numbers to be used to reach the target number.
- Give more/less time or remove the timer altogether.
- Many game shows play a version of this game, show your students a clip to add excitement! Caution: Not all of these shows are family- or classroom-friendly, so choose shows/clips with care.

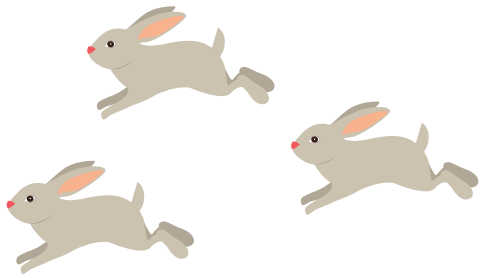
Nine Rabbits in a Burrow

Goal

There are nine rabbits in a burrow. The rabbit deepest in the burrow (red circle) is late for a very important date and needs to get out. Move the late rabbit from the right end to the left end by moving the other rabbits (green circles) out of its way.

Rules

- Rabbits can only be moved one at a time and only into an empty space.
- Two rabbits can't occupy the same space.
- Rabbits can't jump over each other since the roof of the burrow is very low.

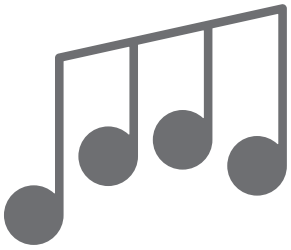


Starting Diagram

Exit ←

Arpeggios

Players: 2



Materials:

- Paper and pen for each player
- A pair of ten-sided dice (or regular six-sided dice)
- Player assignments
  - One player is an 'ascender'
  - One player is a 'descender'

Goal: Create a list of ten numbers in ascending/descending order, depending on your player assignment.

Rules

- To begin, the ascender rolls the dice. Each die represents a digit, and they can be combined in any order, to make a two-digit number. The ascender may either:
  - **Keep**: Pick one of these two-digit numbers and place it on the next spot on their list

    OR
  - **Pass**: If the ascender passes, the descender has the option to steal the dice and put them on their list or pass on the dice as well. If the descender takes the dice, this will count as their turn.

- Next the descender would roll the dice and decide if they want to use the numbers or pass (unless they already took the ascender's dice as their turn).

- **Once per game** – only once! - **a player may break their ascending/descending pattern**. This may happen at any time; no need to announce it in advance.

- Repeating the same number twice in a row is not allowed.

- The winner is the first player to list 10 numbers in ascending/descending order.

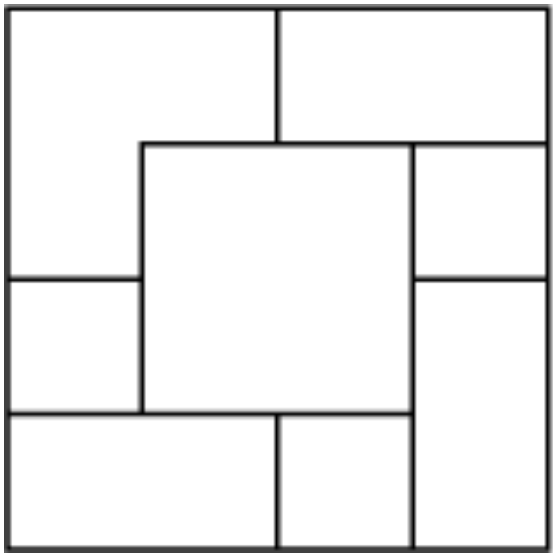
Ascender	Descender
15	62
23	46
32	41
51	32
53	24
7	64
14	41
23	35
	21
	11

Winner!

Eight Squares

Place eight 2 × 2 squares on a 4 × 4 square with the smaller squares overlapping one another to produce each of the two configurations below.

Puzzle 1



Puzzle 2