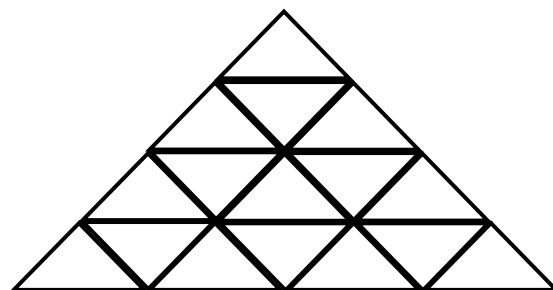


# TEACHERS: RESOURCES AND DEMONSTRATIONS

## Math in Art – Self-Guided Tour for Grades 9-12

1. As you walk through this amazing Gallery in our national capital, you may not have known that Ottawa is the 4th largest city in Canada with an area of 2,760 square kilometers. Can you figure out or guess the other three cities?



2. The exterior of the gallery is clearly a mathematical treasure! One fascinating section is the isosceles triangle in the Great Hall, which is made of tessellating stacked triangles. It looks something like this:
  - a. How could you determine the angle on one glass panel of the triangle?
  - b. Is the angle on the large triangle the same as the angle on the small triangle? Explain your answer.
  - c. How is the diagram above different from the actual exterior design? How could we determine this?
  - d. How many triangles are there in this diagram? *You need to be careful when answering this question!*

# TEACHERS: RESOURCES AND DEMONSTRATIONS

3. CBC reported in 2001 that *Baffin Island* by Lawren Harris, a member of the Group of Seven, was sold at auction for \$2.2 million. Admission to the National Gallery costs \$3 for a student, while an adult pays \$6.

a. How many students and adults would it take to cover the cost of that painting?

b. What is the maximum number of students that could visit the Gallery and the maximum number of adults that could visit in order to cover the cost of the painting?

c. What situation gives the most even distribution of teachers and students?

d. Create a graph and indicate on the graph the two different scenarios discussed above.

4. Next to each artwork is a small label with information about the piece. Find a favourite sculpture, and read the label accompanying it.

Are the number of letters  $>$  the product of the (individual) digits on the label?

5. Step up to the mathematics in this question! Find a set of stairs leading to the Upper galleries.

a. At what angle are the stairs oriented? Are the stairs themselves perpendicular to each other? Do they feel different when you walk up or down?

# TEACHERS: RESOURCES AND DEMONSTRATIONS

- b. Are all the stairs consistent? What may be the reason for changing the angle on the stairs?
- c. Is there more area on top of the step than there is on the riser?
- d. Measure the angle of the entire staircase and then determine how many stairs it takes to get to the first landing.
- e. Using some version of rise and run in these stairs, calculate the slope of the staircase.
- f. Is the angle consistent throughout the stairs? Is the slope consistent?
- g. Do these stairs present a linear or a non-linear equation?
6. Find works of art that best express the terms below, in the mathematical sense. Describe briefly how each is illustrated. *A glossary of terms is provided at the end of this tour.*

<b>Hypotenuse</b>	
-------------------	--

# TEACHERS: RESOURCES AND DEMONSTRATIONS

<b>Opposite</b>	
<b>Parallel</b>	
<b>Perpendicular</b>	
<b>Pattern</b>	
<b>Polyhedron</b>	
<b>Prism</b>	
<b>Symmetry</b>	
<b>Tessellation</b>	
<b>Transformation</b>	

7. Let's go hunt for some paintings. It would be best to stay in one gallery. For each of the following questions, record the details of the work of art.
- a. Which painting has the largest area?



# TEACHERS: RESOURCES AND DEMONSTRATIONS

- a. A perfect square
  - b. A perfect cube
  - c. Abundant, deficient, or perfect
  - d. Triangular, square, or pentagonal
9. There are thousands of works of art in the Gallery's permanent collection. For this exercise let's assume that there are 10,000 images.
- a. How many do you think you could see just by walking around today?
  - b. What percentage of the galleries total images do you think you have seen today?
  - c. Provide an estimate and determine a strategy for how you would be able to come up with a more accurate estimation without counting each one!
  - d. If you saw the same number of works, but different ones each day, how many days would it take you to see the entire permanent collection?

# TEACHERS: RESOURCES AND DEMONSTRATIONS

- e. Which of the following expressions are equal to 10000? Use a check mark to indicate your choices. Include some work to show how you arrived at your decision. Except for the last question, you should be able to determine which is equal to 10000 without using a calculator.

$10^4$	
$10 \times 4$	
$2^4 \times 5^4$	
$2 \times 2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 5 \times 5 \times 5$	
$(1 + 2 - 3 - 4)^2 \times (5 - 6 - 7 - 8 - 9)^2$	
$2 \times 4 \times 5 \times 4$	
$\frac{1000}{0.1}$	
$\sqrt{100000000}$	
$60^2 + 80^2$	
$\frac{28}{2.8} \times \frac{28}{2.8}$	
$2^{13.28771238}$	

10. Make up one math question that relates to any of the pieces you have seen in the gallery.

# TEACHERS: RESOURCES AND DEMONSTRATIONS

## Glossary

**Composite** – a number with more than two factors (opposite of prime)

**Cube** – (as in perfect cube) – a number that can be expressed as the product of three identical whole number factors

**Hypotenuse** – the longest side on a right-angled triangle

**Opposite** – opposite angles are a pair of angles that are formed by the intersection of straight lines and do not share an angle arm – opposite numbers are two numbers that have the same numeral but have the opposite signs

**Parallel** – lines that are the same distance apart

**Pattern** – repeated design or recurring sequence

**Perfect square** – a number that can be expressed as the product of two identical number factors

**Perpendicular**- at right angles to the horizon, or two lines that intersect at right angles

**Polyhedron** – a solid (three-dimensional) shape with plane faces

**Prime** – a number that can only be divided evenly by itself and one

**Prism** – a solid three- dimensional shape with two identical parallel bases – all other sides are parallelograms

**Symmetry** – when one half of an object is the mirror image of the other half

**Tessellation** – a pattern of shapes that fit together without any overlaps or gaps

**Transformation** – a change in position or size, including reflections, translations, rotations, or enlargement

# TEACHERS: RESOURCES AND DEMONSTRATIONS

## Answer Page

2. **a.** Toronto  
Montreal  
Vancouver
- b.** The angles are sitting on top of one another, which makes them similar – so yes!
- d.** There are  $1+3+5+7 = 16$  small triangles (side length one).  
There are 7 medium triangles (side length two).  
There are 3 large triangles (side length three).  
There is 1 extra large triangle (side length four).
- So that is  $16+7+3+1 = 27$  total.
3. **a.** Many different answers are possible here. One way would be to have \$300 000 ( $3 * 100 000$ ) paid by the children and the remaining \$1 900 000 ( $5 * 380 000$ ) paid by the adults.
- b.** 733 333 students could go with 0 adults  
440 000 adults can go with 0 students