# Nets, Surface Area & Volume: Student Activity Lesson Plan

**Subject/Strand/Topic:** Math  
Measurement & Geometry  
Measurement and Trigonometry

**Grade(s) / Course(s):**  
9: MFM1P, MPM1D  
10: MFM2P

**Ontario Expectations:**  
MFM1P: MG2.05  
MPM1D: MG1.03, MG2.05, MG2.06  
MFM2P: MT3.04

**Key Concepts:** nets, surface area and volume (prisms, pyramids, cylinder, cone)

**Links:**  
http://www.learnalberta.ca/content/mejhm/html/object_interactives/surfaceArea/use_it.html (teacher demo)  
http://www.learnalberta.ca/content/mejhm/html/object_interactives/surfaceArea/explore_it.html (student use)

**Required Materials:** Pre-Assessment/Answer Key, Student Activity Handout, Student Activity Answer Key, Post-Assessment/Answer Key, Calculators, Pencils, Rulers

**Before Starting:** This activity should be used when introducing nets, surface area, and volume or shortly after. A computer lab will be needed (one computer per pair of students)

**Introduction** (~ 10 minutes including pre-assessment)  
1. Distribute pre-assessment to students (approx. 5 minutes)  
2. Distribute activity sheet to students  
3. Introduce learning object to students (students will be exploring the nets, surface area and volume of prisms, pyramids, cylinders and cones)  
4. Access first link above to use as demonstration for class (show each shape to students, manipulate shape using slider, and ask students to identify the correct net below)  
5. During demonstration, students complete Part 1 on worksheet (students follow along and fill in chart)  
6. Q: Where is each of the 3D shapes on the learning object seen in real-life applications? (e.g., architecture, construction, wildlife)  
7. Access second link above and explain how to navigate between different shapes and how to select Volume vs. Surface Area

**Student Activity Handout Explanation** (~ 5 minutes)  
1. Briefly discuss Parts B and C of activity sheet (ensure charts are filled out and all questions answered)  
2. Students should work in pairs but each pair must complete an activity sheet  
3. Remind students to have calculator and pencil on hand

**Use of Learning Object with Student Activity Handout** (~ 20-30 minutes)  
1. At computers, students follow link to the learning object listed under Part B  
2. Encourage students to explore learning object (2 minutes)  
3. Partners take turns controlling computer mouse while other reads worksheet instructions  
4. Part B of activity sheet should be taken up after approx. 10-15 minutes (students switch roles)  
5. Part C of activity sheet should be taken up after approx. 10 minutes
### Consolidation (~ 10 minutes including post-assessment)

Ask students the following questions:

1. **Q:** What is an easy way to remember the volume of a rectangular prism and rectangular pyramid?
   - (Volume of rect. prism is base*h, volume of rect. pyramid is 1/3 (base*h))
2. **Q:** What is an easy way to remember the volume of a cylinder and a cone?
   - (Volume of cylinder is base*h, volume of cone is 1/3 (base*h))
3. **Q:** If two boxes have the same volume, must they also have the same surface area? **(No)**
4. **Q:** What implications does this have for manufacturers of products that come in boxes?
   - (Save costs on packaging by reducing surface area of box, preserve volume of product)
5. Distribute post-assessment (approx. 5 minutes)
Answer all questions fully and show your work.

1. Match each shape to its name: [6 marks]
   
   a. □ □ □ Triangular Prism

   b. □ □ □ Rectangular Pyramid

   c. □ □ □ Cylinder

   d. □ □ □ Rectangular Prism

   e. □ □ □ Cone

   f. □ □ □ Triangular Pyramid

2. Determine the volume of a rectangular prism with length 3 metres, width 3 metres, and height 3 metres. [2 marks]

3. Using your answer from part 2, determine the volume of a rectangular pyramid with the same dimensions. [2 marks]

4. Sketch the net of a triangular pyramid. [1 mark]

5. Use the sketch in part 4 to calculate the surface area of the triangular pyramid if the base area is 5 cm², and the area of each side is 8 cm². [3 marks]
1. Match each shape to its name: [6 marks]
   
   a. [Diagram of Triangular Prism]  b. [Diagram of Rectangular Pyramid]  
   c. [Diagram of Cylinder]  d. [Diagram of Rectangular Prism]  
   e. [Diagram of Cone]  f. [Diagram of Triangular Pyramid]

1. \[ V = lwh \] [2 marks]
   
   \[ = 3 \times 3 \times 3 \]
   
   \[ = 27 \text{ m}^3 \]

2. \[ V = \frac{1}{3} \text{ volume (rectangular prism)} \] [2 marks]
   
   \[ = \frac{1}{3}(27) \]
   
   \[ = 9 \text{ m}^3 \]

3. Sketch the net of a triangular pyramid. [1 mark]

4. \[ SA = \text{base area} + 3(\text{side area}) \] [3 marks]
   
   \[ SA = 5 + 3 \times 8 \]
   
   \[ SA = 5 + 24 \]
   
   \[ SA = 28 \text{ cm}^2 \]
### Part A: Nets Demonstration

For each shape, write its name and sketch its net. [12 marks]

<table>
<thead>
<tr>
<th>Shape</th>
<th>Name</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Cube" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image2" alt="Pyramid" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image3" alt="Cylinder" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image4" alt=" Cone" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Nets, Surface Area & Volume

Part B: Volume

Go to the following link: http://www.learnalberta.ca/content/mejhm/html/object_interactives/surfaceArea/explore_it.html

Make sure that “Volume” is selected for each side of the learning object.

1. Select each shape and notice the volume formula below. What do the formulas for the volume of all shapes have in common? [1 mark]

_______________________________________________________________________________________
_______________________________________________________________________________________

2. Select a rectangular prism on one side of the learning object and a rectangular pyramid on the other.
   a. Adjust the dimensions of each shape using the sliders to fill in the chart below: [6 marks]

<table>
<thead>
<tr>
<th>Trial</th>
<th>Shape</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rectangular Prism</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Rectangular Prism</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Rectangular Prism</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

   b. For each trial, the rectangular prism and rectangular pyramid had the same dimensions. What is the relationship between the volumes of these two shapes? [1 mark]

_______________________________________________________________________________________
_______________________________________________________________________________________

   c. How does your answer in b) relate to the volume equations for the rectangular prism and rectangular pyramid? [3 marks]

   Volume of Rectangular Prism: _________  Volume of Rectangular Pyramid: _________

_______________________________________________________________________________________
_______________________________________________________________________________________

3. What other two shapes have the same relation as that in part 2b? [1 mark]

_______________________________________________________________________________________
4. **Label** the following diagrams and use the formulas given on the learning object to calculate the volume of the following shapes:

   a. Triangular Prism (a = 11, b = 2, h = 3) : [3 marks]

   \[
   V = \quad \text{[image of a triangular prism]}
   \]

   b. Cone (r = 13, h = 20) : [3 marks]

   \[
   V = \quad \text{[image of a cone]}
   \]

**Part C: Surface Area**

Make sure that “Surface Area” is selected for each side of the learning object.

1. Select a cylinder on one side of the learning object.

   a. Determine the surface area of a cylinder with radius 2 cm and height 5 cm using the formula given on the learning object (show all steps): [3 marks]

   \[
   \text{SA} = \quad \text{[image of a cylinder]}
   \]

   b. **Sketch** the net for a cylinder from question 1a) and **label the net** using the same dimensions as above. [3 marks]

   i. How can you determine the surface area of the cylinder using this net? [1 mark]

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
ii. How does the method in b i) compare to the method in a)? [1 mark]

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

2. In general, the surface area of a shape can be found by ________________ the shapes on the net together. [1 mark]

3. A manufacturer produces rectangular boxes with length 3 m, width 5 m, and height 2 m. By increasing the height 2 metres, the volume doubles.
   a. Create two boxes on the learning object with these dimensions (the volume of the second box should be double that of the first).
   b. Does this mean that the surface area of the second box is also double that of the first? Why or why not? [2 marks]
      __________________________________________________________________________
      __________________________________________________________________________
      __________________________________________________________________________
   c. What implications does this have for the manufacturer? [1 mark]
      __________________________________________________________________________
### Part A: Nets Demonstration

For each shape, write its name and sketch its net: **[12 marks]**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Name</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image]</td>
<td>Rectangular Prism</td>
<td>[Net Image]</td>
</tr>
<tr>
<td>[Image]</td>
<td>Rectangular Pyramid</td>
<td>[Net Image]</td>
</tr>
<tr>
<td>[Image]</td>
<td>Triangular Prism</td>
<td>[Net Image]</td>
</tr>
<tr>
<td>[Image]</td>
<td>Triangular Pyramid</td>
<td>[Net Image]</td>
</tr>
<tr>
<td>[Image]</td>
<td>Cylinder</td>
<td>[Net Image]</td>
</tr>
<tr>
<td>[Image]</td>
<td>Cone</td>
<td>[Net Image]</td>
</tr>
</tbody>
</table>
Part B: Volume

Go to the following link: http://www.learnalberta.ca/content/mejhm/html/object_interactives/surfaceArea/explore_it.html

Make sure that “Volume” is selected for each side of the learning object.

1. Select each shape and notice the volume formula below. What do the formulas for the volume of all shapes have in common? [1 mark]
   Formulas all include area of base * height.

2. Select a rectangular prism on one side of the learning object and a rectangular pyramid on the other.
   a. Adjust the dimensions of each shape using the sliders to fill in the chart below: [6 marks]

<table>
<thead>
<tr>
<th>Trial</th>
<th>Shape</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rectangular Prism</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>120 m³</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>40 m³</td>
</tr>
<tr>
<td>2</td>
<td>Rectangular Prism</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>126 m³</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>42 m³</td>
</tr>
<tr>
<td>3</td>
<td>Rectangular Prism</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>64 m³</td>
</tr>
<tr>
<td></td>
<td>Rectangular Pyramid</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>21.33 m³</td>
</tr>
</tbody>
</table>

   b. For each trial, the rectangular prism and rectangular pyramid had the same dimensions. What is the relationship between the volumes of these two shapes?
   The volume of the rectangular pyramid is 1/3 the volume of the rectangular prism. [1 mark]

c. How does your answer in b) relate to the volume equations for the rectangular prism and rectangular pyramid?

   Volume of Rectangular Prism: \( lwh \)  
   Volume of Rectangular Pyramid: \( \frac{1}{3} lwh \)  [2 marks]

   The volume formula for the rectangular pyramid is 1/3 the volume formula for the rectangular prism. [1 mark]

3. What other two shapes have the same relation as that in part 2b? [1 mark]
   Cylinder and cone also have this volume ratio in common.
4. **Label** the following diagrams and use the **formulas** given on the learning object to **calculate the volume** of the following shapes:

   a. Triangular Prism \((a = 11, b = 2, h = 3)\) : [3 marks]

   \[
   V = \frac{1}{2}abh \\
   = \frac{1}{2} \times 11 \times 2 \times 3 \\
   = 33 \text{ m}^3 
   \]

   b. Cone \((r = 13, h = 20)\) : [3 marks]

   \[
   V = \frac{1}{3} \pi r^2 h \\
   = \frac{1}{3} \pi \times 13^2 \times 20 \\
   \approx 3537.73 \text{ m}^3 
   \]

**Part C: Surface Area**

Make sure that “Surface Area” is selected for each side of the learning object.

1. Select a cylinder on one side of the learning object.

   a. Determine the surface area of a cylinder with radius 2 cm and height 5 cm using the formula given on the learning object (show all steps): [3 marks]

   \[
   SA = \pi r^2 + \pi r^2 + \pi rh \\
   = \pi \times 2^2 + \pi \times 2^2 + \pi \times 4 \times 5 \\
   \approx 87.92 \text{ cm}^2 
   \]

   b. Sketch the net for a cylinder from question 1a) and **label the net** using the **same dimensions** as above. [3 marks]

   i. How can you determine the surface area of the cylinder using this net? [1 mark]

   **Add the areas of the three shapes in the net together to find the surface area.**
ii. How does the method in b i) compare to the method in a)? [1 mark]
This is the same method used in part 1a!

2. In general, the surface area of a shape can be found by adding the shapes on the net together. [1 mark]

3. A manufacturer produces rectangular boxes with length 3 m, width 5 m, and height 2 m. By increasing the height 2 metres, the volume doubles.
   a. Create two boxes on the learning object with these dimensions (the volume of the second box should be double that of the first).
   b. Does this mean that the surface area of the second box is also double that of the first? Why or why not? [2 marks]
      Surface area on second box is NOT double that of first box because surface area is not proportional to volume.
   c. What implications does this have for the manufacturer? [1 mark]
      The manufacturer could double the volume of box and save money on packaging (surface area).
Instructions: Answer all questions fully and show your work.

1. Match each shape to its name: [6 marks]
   
   a. \[ \text{Cylinder} \]
   
   b. \[ \text{Triangular Pyramid} \]
   
   c. \[ \text{Rectangular Pyramid} \]
   
   d. \[ \text{Rectangular Prism} \]
   
   e. \[ \text{Cone} \]
   
   f. \[ \text{Triangular Prism} \]

2. Determine the volume of a rectangular prism with length 3 metres, width 3 metres, and height 3 metres. [2 marks]

3. Using your answer from part 2, determine the volume of a rectangular pyramid with the same dimensions. [2 marks]

4. Sketch the net of a triangular pyramid. [1 mark]

5. Use the sketch in part 4 to calculate the surface area of the triangular pyramid if the base area is 5 cm², and the area of each side is 8 cm². [3 marks]
Instructions: Answer all questions fully and show your work.

1. Match each shape to its name: [6 marks]
   
   a. [Diagram] d Cylinder
   
   b. [Diagram] a Triangular Pyramid
   
   c. [Diagram] e Rectangular Pyramid
   
   d. [Diagram] b Rectangular Prism
   
   e. [Diagram] f Cone
   
   f. [Diagram] a Triangular Prism

2. \[ V = lwh \] [2 marks]
   \[ V = 3 \times 3 \times 3 \]
   \[ V = 27 \text{ m}^3 \]

3. \[ V = \frac{1}{3} \text{ volume (rectangular prism)} \] [2 marks]
   \[ V = \frac{1}{3} \times 27 \]
   \[ V = 9 \text{ m}^3 \]

4. Sketch the net of a triangular pyramid. [1 mark]

5. \[ SA = \text{base area} + 3 \times \text{side area} \] [3 marks]
   \[ SA = 5 + 3 \times 8 \]
   \[ SA = 5 + 24 \]
   \[ SA = 28 \text{ cm}^2 \]