

**Gifted Education School Network 2023/24**  
**KLA/ Cluster: Secondary Mathematics**  
**Lesson Design**

*Acknowledgement: This lesson example was adapted/adopted from the tryout by Wah Yah College (Kowloon)*

<b>Key Learning Area:</b>	Mathematics
<b>Level:</b>	Secondary 2
<b>Topic</b>	Application of Trigonometry
<b>Learning Objectives:</b>	<p>For average students:</p> <ul style="list-style-type: none"> <li>● Students can use the tools to measure the lengths and angles to estimate the heights of the buildings</li> <li>● Students can solve the problems relating to trigonometry</li> </ul> <p>For gifted/more able students:</p> <ul style="list-style-type: none"> <li>● Students are able to think about the precision of the measurements in different situations</li> <li>● Students can formulate strategies to solve a challenging open problem involving trigonometry</li> </ul>
<b>Prior Knowledge of students:</b>	<ul style="list-style-type: none"> <li>● Trigonometric ratios</li> <li>● Pythagoras Theorem</li> </ul>
<b>Highlights of this lesson example:</b>	<ul style="list-style-type: none"> <li>● This lesson example demonstrates the merits of exploratory task as a learning tool.</li> <li>● This lesson example gives the students an opportunity to apply the mathematical knowledge.</li> <li>● The less able students start analysing the problem with simple situation while;</li> <li>● Mathematically gifted/more able students can learn deeper through the challenging activities.</li> </ul>
<b>Strategies employed:</b>	In order to cater for the specific learning needs of students in a mixed ability class, differentiation strategies could be employed to maximise the learning outcomes of students. Differentiated instruction helps less able students to get ready for the lesson and gives challenges to the gifted/more able students.

Flow of Learning Activities	Rationale and Tips for Implementation																									
<p><b>1) Investigation</b></p> <ul style="list-style-type: none"> <li>● Measuring Height Using Trigonometry</li> </ul> <table border="1" data-bbox="230 379 1014 695"> <thead> <tr> <th></th> <th>Eye level (m)</th> <th>Horizontal Distance (m)</th> <th>Angle of Elevation <math>\theta</math> (<math>^\circ</math>)</th> <th>Height of building (m)</th> </tr> </thead> <tbody> <tr> <td>Football Goal</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>West Gate</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>_____</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>_____</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Eye level (m)	Horizontal Distance (m)	Angle of Elevation $\theta$ ( $^\circ$ )	Height of building (m)	Football Goal					West Gate					_____					_____					<ul style="list-style-type: none"> <li>✧ Ask the students to reflect on the process of measuring the height of different objects using trigonometry</li> <li>✧ Ask the students to reflect on the accuracy of their measurements and calculations.</li> </ul>
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<p><b>2) Development</b></p> <ul style="list-style-type: none"> <li>● Students are asked to find the values of some extreme values of tangents such as <math>\tan 1^\circ</math>, <math>\tan 2^\circ</math>, <math>\tan 88^\circ</math>, <math>\tan 89^\circ</math>.</li> </ul>	<ul style="list-style-type: none"> <li>✧ Students are asked to evaluate their current designs and think how the accuracy of the measurement could be improved.</li> <li>✧ Students are asked to consider the limitations of using trigonometry to measure height.</li> </ul>																									
<p><b>3) Exploration</b></p> <ul style="list-style-type: none"> <li>● Students are given the worksheet on the application of trigonometric ratio.</li> <li>● Students are familiarized the task with the calculation of viewing angle of the frog at the bottom of the well.</li> </ul>	<p><b>For gifted/more able students:</b></p> <ul style="list-style-type: none"> <li>✧ Teacher can raise problems like the following to arouse the awareness of the relationship between the location of the frog and the change of viewing angle: <ul style="list-style-type: none"> <li>➤ How will the viewing angle change when the frog is moving towards the centre of the well?</li> <li>➤ Is there a maximum or minimum viewing angle when the frog is moving around the bottom of the well?</li> </ul> </li> </ul>																									

**4) Consolidation and Stretching the potential**

- Set the height of the well and the radius of the base to be variables so that it becomes an open problem.
- If the capacity of the well is constant, how the relationship between the height and base radius be set in order for the frog to attain a maximum viewing angle.

**For average students:**

- ◇ Ask the students to set up formulas and equations for various relevant quantities.

**For gifted/more able students:**

- ◇ Teachers may ask them to design another well with another shapes such that the capacity is given and the viewing angle is maximum.