

MEASUREMENT OF HEIGHT AND DISTANCES

3.20.2019

Subject

Mathematics

Prepared By

[Instructor Name]

Grade Level

5

Overview

This lesson plan covers teaching content for;

1. Measurement of heights and distance

Objectives

Students should be able to;

1. Describe units of measure
2. use measuring tools
3. Estimate the size of an object using standard and metric units of measurement.

Activity Starter/Instruction

1. The relation between the heights and distances of objects can be understood using trigonometry.
2. Height is the measurement of an object in the vertical direction and distance is the measurement of an object from a particular point in the horizontal direction.
3. If we imagine a line connecting the point of observation to the topmost point of the object then the horizontal line, vertical line and the imaginary line will form a triangle.
4. You can be provided with any two of the following information:
 - The distance of the object from the observer.
 - The height of the object.
 - Angle at which the observer views the topmost point of the object (angle of elevation)

Teacher Guide

Day 1/ Lesson 1: 20mins

1. All you need for this activity is a piece of paper and a tape measure. No calculations are necessary.
2. Fold a piece of paper in half so that it forms a triangle. If the paper is rectangular (not square), you'll have to make a rectangular sheet of paper into a square.
3. Fold one corner over so it forms a triangle with the opposite side, then cut off the extra paper above the triangle. You should be left with the triangle you need.
4. The triangle will have one right (90 degree) angle and two 45 degree angles.
5. Hold the triangle in front of one eye by holding a corner opposite from the 90° right angle, and point the rest of the triangle toward you.
6. One of the short sides should be horizontal (flat), and the other should be vertical (pointing straight up).
7. You should be able to look up along the longest side by raising your eyes.
8. The longest side, the one you'll be looking along, is called the hypotenuse of the triangle.
9. Move back from the tree until you can sight the top of the tree at the top tip of the triangle. Close one eye and

Materials Required

- Protractor
- A piece of string about 30cm or 1 foot long
- Small rock
- Tape measure
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Additional Resources

- https://www.slideshare.net/pranav_asi/height-and-di
- <https://www.tes.com/teaching-resource/ks3-geometry-measuring-height-and-distance-11781093>
- <https://www.kullabs.com/classes/subjects/units/lesson-detail/1611>
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Additional Notes

- The angle at which the observer views the object when the observer is on top of a tower/building (angle of depression)
5. With any two of the information you can calculate the rest.

Guided Practice

Day 2/ Lesson 2: 15 Mins

1. First you make a simple theodolite.
2. Tie a small rock to the end of a piece of string. Attach the other end of the string to the top middle point of the protractor.
3. When you allow the rock to pull the string downwards, gravity will make it hang vertically. Even if you tilt the protractor.
4. First of all, find a good place to stand, about 100 feet or 30m away from the tall building. Make sure that you are standing on level ground and in a safe place. Mark the place with a stick. Now you are ready to measure.
5. To measure the angle, you just point your 'theodolite' towards the top of the tree. Put your eye as close as possible to one edge of the protractor; then, looking along the straight edge, point it directly at the top of the tree.
6. Hold the string and weight in position before you lower the theodolite. Then read the angle from the theodolite as the angle the vertical weight on the string makes with the protractor.

use the other to look directly along the longest side of the triangle, until you see the exact top of the tree.

10. You want to find the point where your line of sight follows the longest side of the triangle to the very top of the tree.
11. Mark this spot and measure the distance from it to the base of the tree. This distance is almost the full height of the tree.
12. Add your own height to this, since you were looking at the tree from the height of your eyes off the ground. Now you have the full answer.

Guided Practice

Day 3/ Lesson 3: 20mins

1. Making the Conversion: Converting between feet and meters is straightforward.
1 meter = 3.28 feet
1 foot = 0.305 meters.
2. To make the conversion between inches and centimeters, you need these conversion factors:
1 inch = 2.54 centimeters
1 centimeter = 0.394 inches.
3. Using this information, you can convert your height in a two-step process. First convert the number of feet to meters, and then convert the number of inches to centimeters. Since a centimeter is one-hundredth of a meter, you can express it as a two-place decimal and add it to the number of meters.
4. For example: George is 5'8" tall.
5. First convert the feet to meters:
 $5 \text{ ft.} \cdot .305 = 1.53 \text{ meters.}$
6. Now convert the inches to centimeters:
 $8 \text{ in.} \cdot 2.54 = 20.32 \text{ centimeters} = 0.20 \text{ meters.}$
7. Add these together to get 5'8" = 1.73 meters.

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7. Adjust your answer to find the angle of elevation, θ , from your eye to the top of the tree.
 8. To find the distance, d , use your tape measure to measure from the stick to the base of the tree, or more exactly to the midpoint of the base of the tree.
 9. You can calculate the height of the tree using a scale diagram on a piece of paper by following these steps:
 - Draw a horizontal line.
 - At a point C near the right end of the line, measure an angle equal to the angle, θ , from your experiment.
 - Choosing a suitable scale, measure the distance x equivalent to the distance d you measured in your experiment. Mark as point B.
 - Draw the perpendicular at B to meet the sloping line at A.
 - Measure the height, y , of A above B.
 10. Using the scale from step 3, convert y back to find the height, h , of the tree.

Summary

1. As the problems are reviewed in front of the class, have the students check their answers for accuracy

Assessment Activity

1. Pupils need to be familiar with unit of measurement.

Assessment Activity

- Assess if students can;
1. Read measurement of heights and distance correctly.