

TxCETP Course Component

Geometry in 3-D

Written by
Ellen Moreland
Angelo State University

Table of Contents

- I. Introduction
- II. Activities

This material is based on work supported by the National Science Foundation under Grant No. DUE 9987332. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect those of the National Science Foundation.

10/12/03

I. Introduction

Objectives: The teacher understands:

- Measurement as a process.
- Geometries, in particular Euclidean geometry, as axiomatic systems.
- The results, uses, and applications of Euclidean geometry.
- Coordinate, transformational, and vector geometry and their connections.

Prerequisites: Algebra I, Geometry, Algebra II, Pre-Calculus

Materials: Graph paper
Calculator
Straight edge

Game Plan: This is intended primarily for use in capstone courses for pre-service mathematics teachers.

Resources:

Ellen Moreland
Angelo State University
Ellen.Moreland@angelo.edu

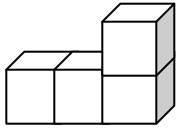
II. Activities

1. A polyhedron is a 3-dimensional figure whose surfaces are made up of polygons. A net is a 2-dimensional pattern that when folded forms a polyhedron. Draw a net for a square pyramid whose base is 6 units on each side and whose slant height is 5 units. Also, find the lateral area, surface area, and volume of the pyramid. Follow these steps:
 - a. Name all of the 2-dimensional figures that will be part of the net. Also, give dimensions for each. For example, if a figure is a triangle, give the base and height. (Hint: You might need to use the Pythagorean Theorem to calculate the height of the triangles.)
 - b. On graph paper, draw the base of your net.
 - c. Identify all the figures that will touch the base and sketch them adjacent to the sides of the base. Be accurate on your graph!
 - d. Check to see if you need to add any figures to your net.
 - e. Calculate the area of each face in your net.
 - f. The lateral area of a prism or pyramid is the sum of the areas of the faces that are not bases. Calculate the lateral area of this pyramid by using your net.
 - g. The surface area of a polyhedron is the sum of the areas of all faces. Use your net to calculate the surface area of this pyramid.
 - h. There are 7 different nets for a pyramid with a square base. Draw as many as you can.
 - i. Find the volume of the pyramid in cubic units.
 - j. If one unit is equal to three giglets, use dimensional analysis to find the lateral area and surface area of the pyramid in square giglets and the volume in cubic giglets.
2. A regular hexagonal prism has bases with sides of 6 units. The height is 10 units. Using graph paper, construct a net for this solid. Then, calculate the lateral area of the prism, the surface area of the prism, and the volume of the prism. Give exact answers. Show all work.
3. Create a net for each of the following:
 - a. a right cylinder
 - b. a tetrahedron
 - c. a dodecahedron
4. A cross section is a figure formed by the intersection of a solid and a plane. For example, if you cut straight through a sphere, the cross section is a circle. Describe each of the following cross sections.
 - a. a plane is drawn through a right circular cylinder parallel to the bases
 - b. a plane is drawn through a right circular cylinder perpendicular to the bases
 - c. a plane is drawn through a right circular cone parallel to the base
 - d. a plane is drawn through a right circular cone perpendicular to the base through the apex
5. Conic sections can be obtained by drawing a plane through a double-napped right circular cone (not through the vertex). Explain.

TxCETP Course Component: Geometry in 3-D

This material is based on work supported by the National Science Foundation under Grant No. DUE 9987332.

6. A degenerate conic is obtained when the plane passes through the vertex of the double-napped cone. Explain all the degenerate cases.
7. When a plane and a sphere intersect in more than one point, the result is a circle. These circles are called _____ in non-Euclidean geometry.
8. An isometric drawing of a 3-dimensional object shows a corner view of the object (three sides). A foundation drawing shows the base of the structure and the height of each part. An orthographic drawing shows a top view, front view, and right-side view of the structure. Given the following 3-dimensional object,



sketch an isometric drawing, an orthographic drawing, and a foundation drawing.

9. Use Geometer Sketchpad to create an isometric grid (a grid in which each dot is equidistant from the six dots closest to it) and draw a 3-D skyscraper. Now, draw an orthographic sketch and a foundation drawing for your skyscraper.