



## Advanced Concepts of Geometry

Explore geometric concepts and algorithms using Google SketchUp

Time Frame: 3 Class Periods

### Mathematics

#### Middle School Geometry Lesson plan

In this unit, students will explore two-dimensional and three-dimensional geometry and geometric figures. After viewing *unitedstreaming* video, students will demonstrate real-life geometric applications using Google SketchUp.

#### National Mathematics Standards:

- precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties.
- understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects.
- create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity, and the Pythagorean relationship.
- describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling.
- examine the congruence, similarity, and line or rotational symmetry of objects using transformations.
- use two-dimensional representations of three-dimensional objects to visualize and solve problems such as those involving surface area and volume.

#### Learning Objectives: The student will be able to

- Demonstrate correct mathematical symbolic notation in identifying and describing geometrical shapes.
- Describe how three dimensional shapes can be positioned at specific angles to each other.
- Represent intersecting lines and relationships of angles within a two-dimensional and three-dimensional figure.

*\*Visit [unitedstreaming.com](http://unitedstreaming.com) to see if your school has an account or to sign up for a 30 day free trial*





### Technology components:

- Discovery Education unitedstreaming account (<http://www.unitedstreaming.com>\*)
- Google SketchUp software (free download from <http://sketchup.google.com>)
- Computer with LCD projector and Internet connection
- Access to the Internet for teacher and student based research

### Preparation:

- Preview *unitedstreaming's* video program *The Many-Sided World of Geometry, Program 1: Geometry Basics*.
- Familiarize yourself with Google SketchUp to develop three dimensional figures from two dimensional shapes and to measure angles at intersecting points on figures.
- Review and download any of the models you wish to use from the Google 3-D Warehouse (free and available through the program)

### Prior Knowledge:

- Identification of two dimensional and three-dimensional shapes and their respective properties.
- Measurement of simple angles using lines and points.

### Introduction:

- Use video to review geometrical concepts in *unitedstreaming's The Many-Sided World of Geometry, Program 1: Geometry Basics*.
- Using Google SketchUp, demonstrate how to create lines and shapes and how to measure them at discrete angles.

### Present New Content:

- Brainstorm the geometrical considerations which might exist for someone constructing a house.
- Present Quick Start: Videos 1 and 2 from the Google SketchUp website at <http://sketchup.google.com/tutorials.html>
- Demonstrate for students how to model a three-dimensional figure using Google SketchUp.
- Demonstrate how to measure angles at intersecting points in the figure.
- Use Google SketchUp to present the Example.skp file of a three-dimensional representation of their project.
- Use *unitedstreaming's The Many-Sided World of Geometry, Program 1: Geometry Basics* as a resource for students to further explore and comprehend geometric concepts.





### **Independent Learning Experience:**

- Divide students into collaborative groups. Using SketchUp, students complete an initial design of a house identifying required geometric algorithms and concepts.
- Ask student groups to share their house with other student groups, highlighting geometrical aspects of the building.

### **Cross-Curricular Lesson Extension:**

- Add a science component by considering the addition of windows to the structure. What role do windows play in temperature gain or loss? How do windows reduce the need for electric lighting? Should all sides of a building have the same amount of area devoted to windows?
- Using the area tool, create a bill of materials for the house being designed (ie: x amt of wood, x amt of paint, x amt of wallpaper, etc and calculate the cost).

### **Feedback:**

- The teacher circulates around the room providing ongoing feedback to small groups.
- Student groups should submit a final draft of their building demonstrating algorithms and concepts that were required. Three-dimensional geometric shapes used and the properties of these shapes should also be identified.

### **Assessment:**

- Teacher provides a rubric in advance showing geometric concepts required to design a house. Use the presentations as a performance assessment for students to use appropriate language of mathematics to explain the design of their group's house.

### **Transfer:**

- Provide images of different forms of housing. Student groups can choose one form to research and present a geometrical design of that form. Students can highlight important geometric features of the house, and contrast this against the design of other houses.

### **Citations:**

Many-Sided World of Geometry, The, Program 1: Geometry Basics. Stand Deviants. (2002). Retrieved October 16, 2006, from unitedstreaming: <http://www.unitedstreaming.com/>

