



Geometry at Work: Architects

Explore real-life applications for geometry using Google SketchUp

Mathematics

High School Geometry Lesson plan

In this unit, student groups will explore the role of geometry in architectural design. Students will select a site from Google Earth, and using Google SketchUp design a building for a prospective client for this site.

National Mathematics Standards:

- draw and construct representations of two- and three-dimensional geometric objects using a variety of tools.
- visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.
- use geometric models to gain insights into, and answer questions in, other areas of mathematics.
- use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.

Learning Objectives: The student will be able to

- demonstrate geometric vocabulary required within real-life professions.
- present and contrast group designs and interpretations of buildings with different purposes and within different geographical regions.
- use the language of mathematics to explain what geometric two and three dimensional figures were used in the design and how they were used.
- explain how the chosen shapes and design met the requirements of the “client.”

Technology components:

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

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





Preparation:

- Preview Google SketchUp and *Math at Work: 'John Paul Jones: Architect'* from Discovery Education *unitedstreaming*.
- Determine the purpose and use Google Earth to determine a location for which you would want students to design a building. (You may wish to pose multiple sites and purposes so that students can choose one.)

Prior Knowledge:

- Appropriate mathematics vocabulary relating to geometry
- Knowledge of simple two and three-dimensional figures and their properties

Introduction:

- Students view *Math at Work 'John Paul Jones: Architect'* from Discovery Education *unitedstreaming*. During video presentation, students record key components required for an architect to complete a project.
- Introduce yourself as a prospective client interested in having an architectural firm design a building based upon specific requirements, such as space constraints, purpose of the building, and its relationship to the environment around it, including other buildings.
- You may wish to invite a guest speaker, parent or community volunteer, who is an architect to discuss his craft.

Present New Content:

- Use Media Player or QuickTime to present *unitedstreaming* video segment of *Math at Work: 'John Paul Jones: Architect'*.
- Present Quick Start: Videos 1 through 3 from the Google SketchUp website at <http://sketchup.google.com/tutorials.html>
- Use Google SketchUp to present the Example.skp file.
- Use Google Earth to determine a site for a building. Present Google Earth Workflow 1 video from <http://sketchup.google.com/tutorials.html>
- Have students complete a three-dimensional design for a building using Google SketchUp.

Independent Learning Experience:

- Divide students into collaborative groups. Groups interview prospective client (teacher) discussing ideas and constraints around building design.
- Using SketchUp, have students complete an initial design of a building observing aspects highlighted by architect in *unitedstreaming* segment: collaboration, geometry within design process, and recognizing physical environment, i.e., angle of sun on face





of building at different times of day. (use SketchUp shadow tool to analyze solar implications of proposed building intervention).

- Have student groups share their building with prospective client and other student groups. Students highlight geometrical features of the building, and how the client's demands were accommodated.

Cross-Curricular Lesson Extension:

- Add a social studies component by having student groups research the impact of buildings within different geographical locations and the purpose of zoning laws.

Feedback:

- In the role of prospective client, the teacher circulates around the room providing ongoing feedback to small groups.
- Student groups should submit a final draft of their building demonstrating how client's needs were accommodated. Three-dimensional geometric shapes being considered, as well as the properties of these shapes, should be identified during collaborative planning.
- Teacher will provide comments and guidance on next steps for each group.

Assessment:

- Teacher provides a written description of the building he/she wants designed, listing any constraints such as spatial (area and volume metric) and budgetary requirements. A scoring rubric is developed in advance showing how students will be evaluated against teacher's description of building and how well they used the language of mathematics in describing their model

Transfer:

- Provide images of different buildings. Student groups can choose one to research and explain its design based on purpose and relationship to the local environment. Students can highlight important geometric features of the building, and contrast this with the design of other buildings.

Citations:

Math at Work. Discovery Channel School (2006). Retrieved October 16, 2006, from unitedstreaming: <http://www.unitedstreaming.com/>