

## INSPIRE GK12 Lesson Plan



<b>Lesson Title</b>	3D Geometric City
<b>Length of Lesson</b>	2 days
<b>Created By</b>	Kylie Nash
<b>Subject</b>	Math
<b>Grade Level</b>	9 <sup>th</sup> -12 <sup>th</sup> Geometry
<b>State Standards</b>	Geometry:
<b>DOK Level</b>	DOK 2 Geometry
<b>DOK Application</b>	DOK 2 – Identify, Relate, Construct, Use Contest Clues, Make Observations, Predict, Show, Calculate
<b>National Standards</b>	9 <sup>th</sup> - 12 <sup>th</sup> Geometry
<b>Graduate Research Element</b>	Engineering Design Concepts- Increasing conceptual knowledge by demonstrating engineering concepts of design using shapes and mathematical equations.

### **Student Learning Goal:**

#### State Standards for 9<sup>th</sup> – 12<sup>th</sup> Geometry: Geometry

- 1a) Apply problem solving skills to solve and verify the solutions for unknown measures in similar polygons. (DOK 3)
- 3g) Describe and draw cross sections of prisms, cylinders, pyramids, and cones (DOK1)
- 4c) Solve real-world and mathematical problems involving the lateral area, surface area, and volume of three-dimensional figures, including prisms, cylinders, cones, pyramids and spheres (DOK 2)

#### National Standards for 9<sup>th</sup> -12<sup>th</sup> Geometry and Algebra Standard:

- Use geometric models to gain insights into, and answer questions in other areas of mathematics.
- Analyze characteristics and properties of two and three dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Use visualization, spatial reasoning and geometric modeling to solve problems

Students will be able to be able to practice and use appropriate techniques to solve mathematical problems linked to real world engineering concepts. Construct 3D shapes and apply mathematical equations for solving problems. Students will get experience of calculating the volume and area of 3D shapes.

### **Materials Needed (supplies, hand-outs, resources):**

Writing utensils, construction paper (several packs), tape, glue, markers, colored pencils, scissors, notebook paper, calculators and long table (to place 3D city).



**Lesson Performance Task/Assessment:**

Students will build a 3D city building demonstrating their knowledge and understanding of various 3 shapes. Students will be able to practice constructing 3D shapes, understand the symmetry of the design, and calculate the volume and area of different designs created by the students to accompany problems selected from the textbook.

**Lesson Relevance to Performance Task and Students:**

Allowing students to build 3D models their design ideas will help build their critical thinking skills and expand upon problem solving skills for calculating volume and area of 3D structures. Students get an opportunity to build 3D structures and calculate area and volume of real world applications. Students should get an idea or sense of how engineering plan and model before actually building structures. Simulating real world applications will help strengthen math skills and engineering design concepts to students as well as how math, specifically geometry can be applied to real world applications. Through the use of hands on activities to synthesize and interpret concepts learned in the classroom.

**Anticipatory Set/Capture Interest:**

Students will be divided into groups of 3 (or may be individual projects depending on class size) and told that they are part of a team of engineers and have been selected to redesign their local downtown area. The city must be made using 3d shapes learned in their geometry class to date. Each team or individual is responsible for a different building to be placed in the down town area. The downtown area should include streets, building, stop lights/signs, bridges, water areas, grass or anything they can think of to be included in the downtown area.

**Guided Practice:**

**Day 1**

The instructor will give instructions of what shapes to use to build their city. Each class will contribute 3D structures to the downtown area so by the end of the day all classes would have contributed to the city. Students will be given as much of the material that is needed. The instructor will discuss with the students what types of shapes they should be thinking about and let them design any shape or size building they can imagine. The instructor should tell them to use any of the following shapes including any additional one that the teacher feels appropriate to that particular class:

Cones  
Pyramids  
Rectangles

Squares  
Triangles  
Quadrilaterals

Prisms  
Cylinders

The instructor will discuss how this application can be applied to other real world applications. The instructor will set up a table in the classroom long or wide enough to



hold several 3D shapes. Teacher will instruct students to label and draw windows, doors or any other design feature to make their structure look as real as possible.

### **Day 2**

The instructor will allow students who have not completed their structures to finish up and place them in Geometric City. The instructor will pick out several structures (least complicated design to most complicated design depending on class) and measure each of the selected structures dimensions (height, length, width/base) in “cm” or “in” and place the dimensions on the board or overhead. Tell the students to use those dimensions to first identify the shape and calculate the area of the structure. If there are not enough good designs this can serve as a supplement to problems or exercises from their textbook. If students are not using the textbook then they should be given the equations for calculating various 3D shapes (handout or on board).

### **Independent Practice:**

#### **Day 1- 3D City Structures**

Students will divide into groups or individually use construction paper and the rest of the materials provided to make 3D structures that resemble downtown buildings in their local town or city. Students can be as creative and make them as small and large as possible. Students should add design features such as doors windows, signs and etc., as well as put their team name, logo or individual name somewhere on the structure.

#### **Day 2- Calculating Area & Volume**

Students should identify what type of 3D figure each represents and use the correct formula/equation to solve for the volume and area of each of the selected 3D structures. Students will turn their work in for a grade.

### **Remediation and/or Enrichment:**

#### **Remediation:**

Individual IEP, shorten activity to 1 day by bringing in pre-made 3D structures that represent different style city buildings and let students practice calculating area and volume of the different shapes.

#### **Enrichment:**

This activity can be extended to calculating various shapes around the school or in the classroom.

### **Check(s) for Understanding:**

1. Discuss the connections between styles/shapes and the formulas that match the shapes.
2. Discuss the relationship between the shapes, size, area and volume of the 3D shapes.



3. What parts of the presentation and activity did you feel was the most important to helped create the 3D structures and why?

4. What parts of the presentation and activity did you feel was the least important to helped create the 3D structures and why?

**Closure:**

Discuss some real world applications (who, what, when, where and how) that would benefit from understanding concepts related to 3D geometric shapes and their area and volume. Discuss the relationship between the shape and volume or area and how it applies to real world applications.

Ex. A water tower is a Cylinder so, what is the importance of the shape and volume or area? Answer: the shape size and volume will determine how much water the tower can hold.

**Possible Alternate Subject Integrations:**

Geography

Social Studies

Physics

Art

Welding/Shop design

**Teacher Notes:**

Students should be allowed to be creative as possible and their city should be put on display for the school to see especially during parent teach conference nights or other special events at the school.