Final Project Proposal

Title of Lesson: Three-Dimensional Geometric Solids

Grade: 3-5

Curriculum Area: Mathematics

Time Required: 4 Days

Lesson Overview: In this course students will investigate and analyze geometric solids and their properties. The course encourages students to recognize three-dimensional solids in their environment, and perceive their length, width, and depth. Examples of the three-dimensional solids are going to be shown with computer projection. Students will work in groups, and they will discuss with each other the properties of shapes. The students will develop arguments about geometric relationships. They will identify and explore solids by using an online activity. Thus, they will use modeling and visualization. They will prepare a group project in which they create a three-dimensional shape made from any material (by hand or by computer) and they will deliver presentations to their classmates to explain the shape in detail.

Curriculum Standards:

Geometry Standards for Grades 3-5 (NCTM)

- Identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes;
- Investigate, describe, and reason about the results of subdividing, combining, and transforming shapes;
- Explore congruence and similarity;
- Make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions;
- Build and draw geometric objects;
- Create and describe mental images of objects, patterns, and paths;
- Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life
Technology Standards:

NETS*S

1. Creativity and Innovation
   Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.

2. Communication and Collaboration
   Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

3. Research and Information Fluency
   Students apply digital tools to gather, evaluate, and use information.

4. Critical Thinking, Problem Solving, and Decision Making
   Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources

NETS*T

1. Facilitate and Inspire Student Learning and Creativity
   Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

2. Design and Develop Digital-Age Learning Experiences and Assessments
   Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S.

Learning Objectives:

Students will be able to:

1. Recognize the three-dimensional solids
2. Know the length, width, and depth of three-dimensional shapes
3. Know the name of the sides of general geometric shapes
4. Explore properties and features of three-dimensional geometric solids
5. Identify geometric solids in the world around them
6. Improve opinions and arguments about geometric connections
7. Imagine, judge, and model geometric shapes to resolve problems
8. Make physical models of geometric shapes
Resources:

Hardware

- Computer Lab with internet connection is necessary to do activities. This lab should also be available out of school time because students need computers with internet to prepare project assignment.
- Computer projector

Software and Web Site

- Power Point
- Illuminations: http://illuminations.nctm.org/

Materials

- Geometric shapes models to show in class
- Power Point Presentation http://280slides.com/Viewer/?user=12922&name=solidmaterials&fullscreen

Activities:

Day 1:

The class will start by presenting to the students a teacher-prepared power point presentation at the computer projector. The students will see the geometric shapes. The teacher will ask the students first to identify some of those shapes; thus the teacher can see which ones are familiar to the students and which ones are not. The teacher will explain what the shapes look like and how they are called. At the end of the PowerPoint there are real life examples of these shapes. After showing the slides, the teacher may ask questions like- Could you give examples from your house or your daily surroundings. The teacher will then give an example of a solid from around the classroom and start to introduce solids by asking some questions about the shape of the solid. For example, ask what kind of shape is this? Do you know its name? Do you notice the shape’s length, width, and depth? Have you seen this kind of shape around you before? If it is possible for children to go out around school, the teacher can ask the students try to find samples of solids and give a chance for them to explain to their classmates what they find. Encourage students to give their opinion. Teacher should emphasize vocabulary about the geometric solids.
Day 2

Introduce a game which is called Geometric Solids, located at the illuminations web page. Each individual student will spend time exploring the intricacies of the game by rotating the geometric shapes. They can see all around the solids and they can comprehend the solids and their dimensions within the game. After they play the game, the teacher can encourage students to discuss with their classmates about what they discovered while interacting with the game. When the students speak about shapes, pay attention to their words for shapes, and state the correct geometric terms. Ask questions such as, how are the shapes alike? How are the shapes different? Guide students to note the characteristics of solids such as their sides (called faces), the connection of the faces (called edges), and the connection of the edges (called corners). Model these shapes for the students at the projector.

Day 3

Students play the Geometric Solids game on the Illuminations web site to further their perception of solids. Students will color the faces, edges, and corners of solids by playing the Geometric Solids game. Encourage students to discuss with a partner, who will be the student next to them, how they colored the solids. Distribute an activity sheet which is found on the Illuminations website to the students, where they will complete a table with columns for the solid’s name and a picture of the solid. Help students complete the directions on the activity sheet. Give them time to think about the three questions comparing the number of faces, vertices, and corners of the shapes on the Geometric Solids activity sheet after they complete the table, and discuss the questions on the sheet. Ask the students to partner with a friend for the next group project. In the project, give the students some supplies and materials from outside of the class for students to create solids. For example, give grid paper to draw a solid and then give sticks (match, straw, etc.), and gum to create solids. Give instructions to the students to do geometric solid models with any material they find in the classroom with their partner for this group project.

Day 4

Students introduce their group projects to the class. Give evaluation sheets to students to evaluate their classmates’ presentations. Ensure that students ask questions to their classmates. It is important that the students give their ideas and discuss with each other about their classmates’ presentations. The teacher may want to prepare a set of questions that increasingly progress in difficulty. Some challenging questions would also be appropriate in order to reinforce critical thinking skills. For instance, one challenging question could be: Why are houses mostly square or rectangular in shape?
Assessments:

Students can be assessed by reviewing their activity sheet. Their group project will also be a big part of their grade. In addition, participation in the discussions can be assessed. How students’ competency is developing about the geometry and how they are doing in group projects can also be assessed. Their ability to state geometrical terms correctly, their thinking in an appropriate way, and their understanding of geometric concepts with computer-based applications should be assessed and feedback should be given to the students frequently. Teacher should record and observe data about students’ improvement of skills, and knowledge.

Interdisciplinary Connections:

Social Science and Natural Science:

Students will learn how they can discuss and communicate with each other. Students will learn about various shapes and this can help them to develop models for representing and predicting information. In addition their critical thinking skills will improve by criticizes their peers, dealing with problems will progress as well; they can transfer these abilities to the other sciences.

Art:

They will practice drawing and color harmony by drawing solids and coloring them in the Geometric solid game.

Helpful Notes:

- Interact with students and give feedback frequently.
- Scaffold the various examples to the students easy to difficult. Cube seems to be easiest one for students to understand. The teacher can then move on to the rectangular prism, triangular prism, and so on.
- Be sure that when students work on the group project, they contribute equally. Ensure that all the students take an active part. One way to ensure that all students contribute equally is to assign them group roles (each student in the group will have a specific role. If they do not perform their role the project won’t get completed.)
- It is recommended to modify the power point and examples for the particular needs of the teacher (i.e., add more slides about shapes, teacher can add additional conceptual information about the shapes).
- The teacher can reinforce students’ understanding by bringing some solid material samples.

Theory to Practice Connection:

This unit emphasizes discovery. It allows students to explore geometric solids. It also ensures that students discuss with each other about shapes and their features and properties; thus they
improve their skills in discussing their ideas and their critical thinking skills will be promoted by critiquing their peers’ ideas. According to cognitive research, this unit is effective for learning because the following “four fundamental characteristics of learning are present: (1) active engagement, (2) participation in groups, (3) frequent interaction and feedback, and (4) connections to real world contexts” (Roschelle et al., 2000, p. 79). Computer-based applications and the other activities in the unit expand students’ understanding of geometric shapes and mathematical concepts. Because students are more active and productive in the class, students’ understanding of the subject is enhanced. Also students’ collective understanding of the topic improves as they are working together with peers. Visualizations and modeling in the computer-based application make the lesson more effective for learning and teaching concepts. Also by doing the project, the students engage in their own learning. Thus, this makes learning more long-lasting and practical.

Reference

### Rubric for Class Activity Sheet

#### Exploring Geometric Solids

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4 - Proficient</th>
<th>3 - Satisfactory</th>
<th>2 - Basic</th>
<th>1 - Unsatisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Numbering of Sides, Edges, Vertices</td>
<td>Student gave the correct number of sides, edges, vertices, for all or 5 of the 6 geometric solids given.</td>
<td>Student gave the correct number of sides, edges, vertices, for at least 3 of the 6 geometric solids given.</td>
<td>Student did not give the correct number of sides, edges, vertices, at least 1 of the 6 geometric solids given.</td>
<td>Student did not give the correct number of sides, edges, vertices, for any of the given geometric solids.</td>
</tr>
<tr>
<td>Correct Identification of Geometric Solids</td>
<td>Student correctly identified the name of all or 5 of the 6 geometric solids given.</td>
<td>Student correctly identified the name of 3 or 4 out of the 6 geometric solids given.</td>
<td>Student correctly identified the name of 1 or 2 out of the 6 geometric solids given.</td>
<td>Student did not correctly identify any of the geometric solids given.</td>
</tr>
<tr>
<td>Completion of Questions</td>
<td>All questions are correctly completed.</td>
<td>All but 1 of the questions are completed.</td>
<td>All but 2 of the questions are completed.</td>
<td>All of the questions are not completed.</td>
</tr>
</tbody>
</table>
## Rubric for In Class Performance (Discussions)

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4 – Proficient</th>
<th>3 - Satisfactory</th>
<th>2 - Basic</th>
<th>1 - Unsatisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class participation</strong></td>
<td>Stays actively involved during class and regularly volunteers to answer questions.</td>
<td>Almost always actively involved in the lesson and occasionally volunteers to participate in discussion.</td>
<td>Normally stays involved in the lesson, but rarely participates in class discussion.</td>
<td>Often is not involved in the lesson and often works on homework for other classes during class.</td>
</tr>
<tr>
<td><strong>Respect for other speakers</strong></td>
<td>All statements, body language, and responses were respectful and were in appropriate language.</td>
<td>Statements and responses were respectful and used appropriate language, but once or twice body language was not.</td>
<td>Some statements and responses were not respectful and in appropriate language.</td>
<td>Statements, responses and/or body language were consistently not respectful.</td>
</tr>
<tr>
<td><strong>Listening</strong></td>
<td>Student consistently had eyes on current speaker or had book opened to page currently being discussed.</td>
<td>Student mostly had eyes on current speaker or had book opened to page currently being discussed.</td>
<td>Student occasionally had eyes on current speaker or had book opened to page currently being discussed. Student often seemed restless or bored; staring out window or fidgeting.</td>
<td>Student rarely had eyes on current speaker or had book opened to page currently being discussed. Student seemed consistently bored; staring out window or fidgeting.</td>
</tr>
<tr>
<td><strong>Problem solving</strong></td>
<td>Actively looks for and suggests solutions to problems.</td>
<td>Refines solutions suggested by others.</td>
<td>Does not suggest or refine solutions, but is willing to try out solutions suggested by others.</td>
<td>Does not try to solve problems or help others solve problems. Lets others do the work.</td>
</tr>
<tr>
<td><strong>Asking Questions</strong></td>
<td>All of the following question asking elements is present: original, related to topic, well formatted. And student was able to redirect or expand on question, if asked.</td>
<td>All of the following question asking elements is present: original, related to topic, well formatted.</td>
<td>Only two of the following question asking elements is present: original, related to topic, well formatted.</td>
<td>Only one of the following question asking elements is present: original, related to topic, well formatted.</td>
</tr>
<tr>
<td><strong>Attendance</strong></td>
<td>Always attends class and is on time.</td>
<td>Almost always attends class, and is tardy very rarely.</td>
<td>Attends class regularly and is tardy on occasion.</td>
<td>Frequently is absent from class meetings and is usually tardy when attending class.</td>
</tr>
<tr>
<td>CATEGORY</td>
<td>4 – Proficient</td>
<td>3 - Satisfactory</td>
<td>2 - Basic</td>
<td>1 - Unsatisfactory</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Knowledge of Model Construction</strong></td>
<td>The students can clearly describe all of the steps and materials used to make their model.</td>
<td>The students can clearly describe most of the steps and materials used to make their model.</td>
<td>The students can describe half of the steps and materials used to make their model.</td>
<td>The students have great difficulty describing how their model was constructed.</td>
</tr>
<tr>
<td><strong>SolidWorks Model Construction</strong></td>
<td>SolidWorks model shows creativity and is well designed. Different construction techniques have been used.</td>
<td>Model is well thought out and designed. Design does not take full advantage of SolidWorks capability.</td>
<td>Model does not show creativity and the technical detail is also lacking.</td>
<td>Model shows a lack of understanding of SolidWorks.</td>
</tr>
<tr>
<td><strong>Explanation of Model</strong></td>
<td>Explanation is detailed and clear with all of the class reaching same conclusion using stated procedures.</td>
<td>Explanation is clear with most of the class reaching the same conclusions with only minimal elaboration from team.</td>
<td>Explanation is a little difficult to understand, but includes critical components requiring major elaboration to get same conclusions.</td>
<td>Explanation is difficult to understand and is missing several components OR was not included with few reaching same conclusions.</td>
</tr>
<tr>
<td><strong>Group Work</strong></td>
<td>Cooperates with team and is helpful; shows good teamwork; evenly shared workload.</td>
<td>Cooperates with team, but uneven workload.</td>
<td>Somewhat cooperates and uneven workload.</td>
<td>Fails to show good teamwork.</td>
</tr>
<tr>
<td><strong>Geometric Terms</strong></td>
<td>Correct and appropriate geometrical terminology are always used</td>
<td>Correct and appropriate geometrical terminology are usually used</td>
<td>Correct and appropriate geometrical terminology are sometimes used</td>
<td>There is little use, or a lot of inappropriate use of terminology</td>
</tr>
</tbody>
</table>