

**Title –** Let's net the solids!

**Description -** Students understand the art of representing solid objects on a flat surface and design 2-D nets for various solid figures.

### **Goals –**

1. To understand and learn the art of representing solid objects on a flat surface
2. To visualise solid shapes or combinations of solid shapes all around them.
3. To introduce students to the concept of architecture and Engineering Design.

### **Pre requisites –**

1. Knowledge of 2-D polygons.
2. Knowledge of basic 3-D shapes and terms like faces, edges, vertices.
3. Idea of what robot models look like.

### **Instructional Objective(s)**

*At the end of the lesson, students should be able to:*

1. Visualise solid shapes in 2-Dimensional plane.
2. Identify the hidden parts of 3-D figures and estimate their space.
3. Match the nets to their respective solid figures.
4. Design and create nets for 2-D representation of various 3-D objects.
5. Design and create a 3-D Robot with movable limbs.

## Material Needed

### For each student:

1. Engineering Design Process Workbook.

### Architectural Engineering Activity

### **LET'S NET THE SOLIDS!**

Name : Class :

Subject : Date :

Team name : Model name :

Aim of the activity :

Individual contribution  
to the team :

Material(s) used :

Process of thought and action :

## Instructional Resources

### Introduction –

Ascertain students' prior knowledge about 2-D polygons and 3-D shapes. Kindle their minds by encouraging a large group discussion about the 3-D solid figures they use or see round them. Put forward some questions like

1. What are 3-D figures? Are they related to 2-D figures in any way?
2. In your day to day routine what are the 3-D objects you come across?
3. How are packaging boxes of different sizes and shapes for cakes, burgers and sweets made? (After discussion Teacher can dismantle a readymade box and show the 2-D representation of the same)
4. What kind of 3-D shapes would you use to make a robot which is sturdy?
5. How can we design our own 3-D solid using paper sheets? (After the discussion teacher can demonstrate the making of a simple joker cap to initiate the concept of nets) Conclude the discussion by showing them the video with link <https://www.youtube.com/watch?v=7uAbGoGYLcc> which will also recapitulate the required prerequisite knowledge.

Divide the class in groups of 5 and give each group a K-W-H-L chart. Have each group fill 'K', 'W' and 'H' columns about 2-D representation of 3-D shapes. Check and discuss K-W-H-L charts with each group.

Inform the students that they are going to design nets to make the solid shapes to learn 2-D representation of solid shapes and also to create a 3-D Robot which can stand steady on a flat surface and have movable limbs.

1. Pass the set of required stationary to each group.
2. Instruct the students that they have to design the net for the required shapes on the graph sheet, trace it on the chart paper and form the solid figure.

### Integration of the concept with other STEM Subjects:

*(Information can be provided here about the interpretation of the topic in other STEM subjects. This information can be used by students while designing in their project/working on the given problem)*

Topic as integrated with Science- Realising the importance of mathematics (measurement) in the field of science while developing machines needing appropriate balance, shape, size etc.

Topic as integrated with English- Composing jingles and writing dialogues for the presentation. Articulating an advertisement for print media..

# Engineering Designing/STEM Based Project

## Introduction

To start, you may want to watch the - What is Architectural Engineering video below.

[https://www.youtube.com/watch?v=-8sucrV14\\_c](https://www.youtube.com/watch?v=-8sucrV14_c)

## Part – 1 - Designing and creating the nets

Tell your students that today they all are architects and design engineers who have a challenging project to design a creative model of a robot with required specifications using the 3-D shapes they have constructed. They need to name it and advertise it in the open market to get the best sales!

1. Let the students sit in the made teams and brain storm on how they would like to design their robots and which would be the most appropriate solid figures for the same. Also ask them to choose a name for their design team.
2. Provide them time to draw a design in their workbooks and work backwards on which 3-D shapes would they need to construct?
3. Bring back the class as a whole group and show the videos  
<https://www.youtube.com/watch?v=HiZuAYXDrn0> (intro) and  
<https://www.youtube.com/watch?v=9BOwKajXUvA> that explain different 3-D shapes and their nets. Then have a quick discussion about different designs and shapes involved in things we see around us and use of nets in architecture.
4. Draw a figure of a simple rocket on the black board and ask the students
  - What are the 3-D figures that are present in the model?
  - What can we do to make it more creative and beautiful?
5. Then tell them they need to make the 3-D figures with proper measurements to keep the sizes of the various shapes in proportion
6. Pass the net designing workbook to each student.

## **Part – 2 – Students construct the 3- D solids and build a 3-D Robot using them.**

1. Instruct and encourage each team to distribute their workload evenly among the members for timely completion of the project.
2. Initiate the discussion within groups to brainstorm and design creative robots. Teacher can take them through the video <https://www.youtube.com/watch?v=x1Booigmwyo> to give them a fair idea of how they have to go about the project. Encourage them to be innovative and make their robots sturdy, attractive and user friendly.
3. The students who need assistance with the nets can be given the sheet listing solids and their respective nets.
4. Once the 3-D figure(s) are made the team gets together to collate their work and construct their robot models.
5. Ask the teams to give their models a trendy and interesting name with their specifications and features.

## **Part – 3 – Test and Re- Engineering**

1. The students will test their robots to see if they stand steadily on the surface and their arm and legs can move in the required directions.
2. If the robots are flimsy or unable to satisfy the required specifications, the students need to redesign their model by trying to replace the 3-D shapes with more appropriate one.

## **Part – 4 – Advertising and presentation**

Have the students advertise their final models and evaluate other team's models

1. Provide students' time to make a presentation of their robots. Encourage them to give their robots fancy names and highlight their capabilities and unique features (e.g. play the drums, move heavy weights, fly etc). Allow the students imaginations to run wild – The advertisement can be in any form the group decides (jingle/act/print media)
2. Again Orient students on the timeline and the roles for each student.
3. Students present their creations
4. A question answer round is opened to the student which is led by the teacher
5. To conclude ask the students to fill the summative questions in the workbook  
Culminate the activity by asking students to reflect on the entire design process. Have students fill in the L column of the K-W-H-L

### **Extensions/Enrichment Activity**

1. Collect pictures of famous super heroes like superman, GI Joe, Spiderman etc and ask the groups to make 3-D models of them
2. Discuss the famous monuments of the world and explain the various shapes used in them. Also discuss the architectural designing and layout of the same on 2-D sheets.

## Assessment and Rubrics

### Pre-activity – Discussion questions

1. What would the world be like without the concept of 3-D shapes?
2. Is it possible to visualise every 3-D object on a paper? Are all the parts visible?
3. Why is architecture a discipline of the engineering course?  
What do you know about engineering drawing?
4. Why is it necessary to represent 3-D shapes on a 2-D plane?
5. How and why are 3-D models designed before moving ahead with the actual construction?

### Activity Embedded – (Formative Assessment)

Evaluate the student handbook to gauge the mastery of the concept (Reviews attached in the workbook)

### Post activity –

Show and tell – Evaluate the student presentation and model using the given rubric. (Individual assessment rubric attached)



group presentation rubric.pdf

## Credits

1. <http://www.skillsyouneed.com/num/3d-shapes.html>
2. <https://www.youtube.com/watch?v=7VEXuJZlhQw>
3. <http://www.wikihow.com/Draw-Shadow-Effect-3D-Block-Letters>
4. <https://www.youtube.com/watch?v=LBJ-kneQ-MY>
5. <https://www.youtube.com/watch?v=CyYn66Zm5n0>
6. <https://www.teachengineering.org/>
7. <https://www.teachingchannel.org/>