EXEMPLAR 17:

Nets and Solids

Objectives: (1) To identify solids and their corresponding nets
(2) To interpret and draw nets

Key Stage: 3

Learning Unit: More about 3-D Figures

Materials Required: Nets, scissors, glues, tapes, a number of cardboard squares, rectangles, equilateral triangles, regular pentagon, etc

Prerequisite Knowledge: Understanding the term "net"

Description of the Activity:

1. At the beginning of the lesson, the teacher displays the cube to students and uses scissors to cut the cube in order to obtain the corresponding net. Then the teacher sticks the net on the blackboard to recall the meaning of net to students.
2. The teacher asks students whether the net obtained is unique. Students are invited to suggest other nets for the cube and draw on the blackboard. The teacher distributes cardboard squares and tapes to students and asks students to check their proposed nets by sticking the squares provided to form a cube.
3. Students are divided into seven groups. The teacher distributes the nets from Appendix A to students. These nets include rectangular block, tetrahedron, square pyramid, triangular prism, pentagonal prism, octahedron and dodecahedron. Each group receives only one kind of the nets. For example, group 1 receives nets of rectangular blocks only, whereas group 2 receives nets of regular tetrahedra, etc. Each student has to cut out the net, fold and stick the edges to form a solid.
4. Each group passes all the solids that they constructed to another group. The teacher distributes the worksheet to students and asks them to draw a net from the solid that they receive.

5. To help students draw a net, the teacher may give the following guidance:
   (a) What types of faces do the solid have?
   (b) Which faces are joined to each other?
   (c) Then select a face of the solid and draw it. Draw the faces which join this face. Continue in this manner until all the faces have been drawn.

6. The teacher asks students to compare the nets they drew within the group. Usually the nets they drew may not be the same. They have to discuss whether their nets drawn can form the original solid.

7. Students can use the cardboard of the corresponding polygons to display their nets on the table. Then they can stick the cardboard together to get the desired solids.

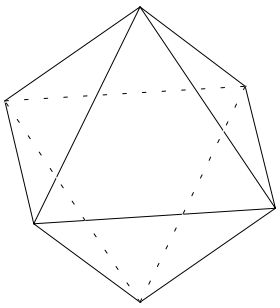
(The following steps are designed for more able students only.)

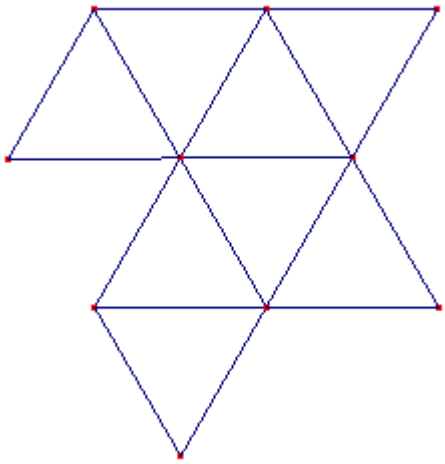
8. Students have to cut out their own solids to get back the net they draw.

9. The teacher discusses with students the problems they find and draws the conclusion that the net may not be unique for a solid.

10. The teacher can pick up some nets that cannot be used to form a solid and ask students to correct it in order to get a desired solid.

For example:
The figure below shows a net which is supposed to be folded to form a regular octahedron. By copying the figure and assembling the solid, it can be shown that there is an error in the net. Students are required to indicate the error and draw the correct version.

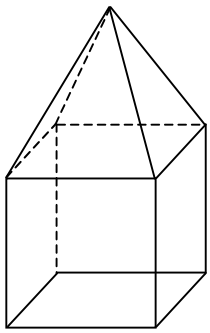




Students can check their amended nets by folding the cardboard.

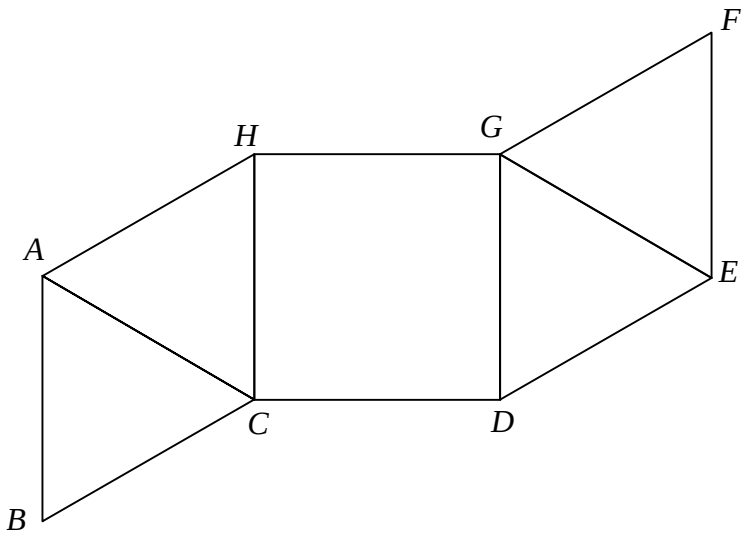
11. The teacher can also ask students to construct the net of the solid in 2-D representation.

For example:
The diagram shows an elongated square pyramid. Please construct the net of this solid on a paper.



12. Besides, the teacher can use the following question to test the spatial sense of students.

The diagram shows a net of a solid figure.
(i) What sort of solid figure is it?
(ii) When the solid is constructed, which letter(s) will point A join?



Worksheet: Net of a Solid

1. You will receive a solid model from other group. Guess the net of the solid by observation and draw it in the space below.

Name of the solid : _____
Net :

2. Compare the net you draw with those drawn by other group members. Are the nets within the group the same? Discuss with your group members whether the net you draw can form the original solid.
3. Use cardboard to display your net. Fold the cardboard to check whether you get the desired solid.

Worksheet: Net of a Solid (For more able students)

1. You will receive a solid model from other group. Guess the net of the solid by observation and draw it in the space below.

Name of the solid : _____
Net :

2. Compare the net you draw with those drawn by other group members. Are the nets within the group the same? Discuss with your group members whether the net you draw can form the original solid.
3. Use the cardboard to display your net. Fold the cardboard to check whether you get the desired solid.
4. Cut out your own solid to see whether you can get the net you draw.

Notes for Teachers:

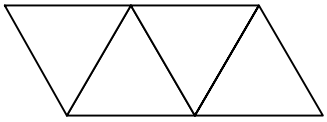
1. A net is a 2D "fold-out" of a 3D solid. Students should have come across the idea of net in primary mathematics. However, it is found that students are still too weak in their spatial visualization especially for more complicated solids. It is expected that through these hands-on experiences, students have opportunities to develop spatial visualization skills (which allow them to mentally imagine a 3D solid from a 2D net). Hence, students are expected to draw the nets and discuss whether the nets can be used to form the solid. Students can change a 2D net to see the effect on the corresponding solid.

2. It should be noted that this exemplar emphases on the development of mental imagination for students. For example, students need to draw the corresponding nets from the 3-D models rather than use scissors to cut out the nets. (Step 4 in the worksheet for more able students is slightly difficult for them because they have to cut the solids to form the nets, which have to be exactly equal to the nets they drew.)

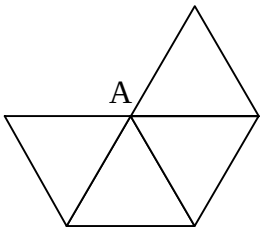
3. Before the lesson, the teacher has to prepare several models of large cubes from the nets in Appendix A.

4. The teacher should bring to the attention of students that there is more than one net representing the same 3-D solid.

   For example, below is another net for the regular tetrahedron.



   Note: Not every net consisting of four equilateral triangles can be folded to form a regular tetrahedron. Here is an example.



   The teacher should help students identify the above cases through discussion and understand why the last net cannot be used to form a tetrahedron (such as the vertex A has 4 triangles attached).

5. Some computer software packages such as *Poly* can demonstrate the folding and unfolding of a solid and its net rapidly. These games can supplement the activities using only paper and models. Please refer to Exemplar 7 in "Teaching Package on S1-5 Mathematics 1: Use of Information Technology", produced by the Mathematics Section of Education Department in 2001 for the details.