Unit three:
Geometry

Syllabus reference

Mathematics Years 7-10 Syllabus, October 2002

Outcomes

SGS2.1 Makes, compares, describes and names three-dimensional objects including pyramids, and represents them in drawings (page 145)

SGS3.1 Identifies three-dimensional objects, including particular prisms and pyramids, on the basis of their properties, and visualises, sketches and constructs them given drawings of different views (page 146)
Activity 3

In this “jigsaw” activity, groups of students become involved in different but connected tasks. Each of these tasks supplies a part of what all students will need to know. The students then come together, in a home group, to exchange and share their information enabling them to complete the final task.

Resources
- Information table (resource 20), one for each group.
- Investigation question (resource 21), one for each group.
- Expert group task cards (resource 22), one for each group.
- Information passages (resources 23a to 23f), three copies of each.
- Worksheet (resources 24a to 24f), one copy each.
- A set of 3D models (cylinder, triangular prism, rectangular prism, rectangular pyramid, triangular pyramid and cube), one for each group.
- Plastic straws and pipe cleaners to make skeletal models, enough for one model per student.
- PMI reflection sheet (resource 25), one per student.

Description
- Group students in their “home” groups. Approximately six students per group.
- Describe the jigsaw activity.
  1. Students will leave their home groups and form a number of expert groups.
  2. Each expert group will complete tasks that are different from those of other groups. By completing these tasks they will become an “expert” on one particular solid.
  3. The students will return to their home groups, bringing with them the expert information.
  4. The home group will share all the information, enabling them to complete the final task.
- Display the final tasks to the students (resources 20 and 21 on OHT). Students will be required to complete a table on various solids and then use this information to answer an investigation question.
- Give each student in each home group a number from 1 to 6.
- Students now regroup into expert groups. All ones together, all twos together.
  1 2
  3 4
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  1 1 1
  2 2 2
  3 3 3
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  5 5 5
  6 6 6
  1-5 = students
  6 = teacher
- Give each expert group their task to complete.
  - Expert group task card (resource 22). This card explains what students are to do.
  - Information passage (resource 23).
  - Worksheet (resource 24), requiring students to complete a vocabulary task and to label a diagram.
- Organise resources (3D models, straws and pipe cleaners) for students to complete their task card.

NB: Teacher could assume the role of expert for one solid and model or demonstrate for students each stage of the jigsaw process.
Activity 3 continued…

- Students are given approximately 25 minutes to complete tasks.
- Students return to home groups, bringing with them the expert information, to complete the final task of compiling the information for the table about the six 3D shapes (resource 20). The home groups then apply this information to write a report on the investigation (resource 21).
- Display reports and models around the room, in the library or at parent/teacher evenings.
- As a conclusion to the activity, have students reflect on the unit of work. A PMI (resource 25) is an efficient way of obtaining this type of student feedback. Simultaneously students are writing about their learning.

- Students need to ask questions of each other to obtain all information. Every student must participate for the home group to complete its task successfully.
- Students are able to practise their retelling skills.
- When using this strategy for the first time, it may be useful to have a second teacher, parent or ESL support in the room.
- Students take an active role in the reading and learning process. The teacher is a facilitator of learning.
- Students have a high rate of retaining information.
- The jigsaw approach adds variety for both teachers and students.
- All readers, both struggling and confident, are given reason and motivation for attempting to comprehend the materials.
- Previewing the final task to the students encourages them to focus on the required information.

<table>
<thead>
<tr>
<th>Name of solid</th>
<th>Shape of solid</th>
<th>Number of flat surfaces</th>
<th>Number of curved surfaces</th>
<th>Number of edges</th>
<th>Number of vertices</th>
<th>Is the shape a prism, pyramid or neither?</th>
<th>Number of equal faces</th>
<th>What is the shape of the base (cross-section)?</th>
<th>Does the shape roll? (Yes/No)</th>
<th>Does the shape stack easily? (Yes/No)</th>
<th>Does the shape stack only if you, bind it and label it?</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
**Investigation question: Home group**

What are the advantages and disadvantages of packaging ice cream in tubs with circular, rectangular or square bases?

**Discussion structure**

- Paragraphs on the advantages and disadvantages of packaging ice cream in each type of tub
- Each paragraph begins with a sentence that previews the information in the rest of the paragraph

**Recommendation:**

- Complete the worksheet called “Building technical vocabulary about 3D shapes”.
- When you return to your original group you will be the expert on your shape.
- STOP! WAIT FOR ALL THE OTHER GROUPS TO FINISH. The teacher will tell you when it is time.
- While you are waiting you might like to read through all your information again.
- Remember: you are the expert now!

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**The cylinder**

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids, but a cylinder is neither of these.

A cylinder can be open-ended. This means that it has one or two ends opened. Some examples of open-ended cylinders would be a pipe and a can without a lid. An unopened tin is an example of a closed cylinder.

A cylinder has one curved surface. It can also have two flat surfaces if it is a closed cylinder. It has two edges, one goes around the top of the cylinder and one goes around the bottom.

The ends of a cylinder are circles that are the same size. If you open the cylinder out, as in the diagram below, you would see that the curved surface is really a rectangle which has been rolled up.

A cylinder has a cross-section which is circular. This means that if a cylinder was closed, all the slices would be circles, just like slices from a cylindrical loaf of bread.

A cylinder is a solid that will roll and stack easily. Cans are regularly stacked in shops.

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**Building technical vocabulary about 3D shapes**

Complete this table by:

a) Looking in the geometrical terms for the words given
b) Adding other geometrical words that you do not understand.

<table>
<thead>
<tr>
<th>Everyday language</th>
<th>Geometrical term (mathematical language)</th>
</tr>
</thead>
<tbody>
<tr>
<td>length, width, depth</td>
<td>length, width, depth</td>
</tr>
<tr>
<td>shape when you slice it</td>
<td>cross-section</td>
</tr>
</tbody>
</table>

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**Cylinder**

![Diagram of a cylinder](image)

Label the parts of the cylinder:

- edge
- curved surface
- flat face
- cross-section

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**Expert group task**

1. Read the information about your shape.
   One student could read the information to the whole group or you may like to read it individually.
2. Underline any words you don’t understand.
3. Discuss these underlined words with the group to discover the meanings.
4. Complete the worksheet called “Building Technical Vocabulary about 3D Shapes”.
5. Now label the picture with the geometrical terms listed on the worksheet.
6. Remember: you are the expert now!
7. Pass the shapes around the group.
8. The tallest person in your group must now collect the equipment needed to build a model of your 3D shape.
9. Everyone in the group must make a model.
   \( \text{STOP! WAIT FOR ALL THE OTHER GROUPS TO FINISH. The teacher will tell you when it is time.} \)
<table>
<thead>
<tr>
<th>Name of solid</th>
<th>Sketch of solid</th>
<th>Number of flat surfaces</th>
<th>Number of curved surfaces</th>
<th>Number of edges</th>
<th>Number of vertices</th>
<th>Is the shape a prism, pyramid or neither?</th>
<th>Number of equal faces</th>
<th>What is the shape of the base (cross-section)?</th>
<th>Does the shape roll? (Yes/No)</th>
<th>Does the shape stack easily? If yes, draw its stacking</th>
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<tbody>
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</table>
### Investigation question: Home group

What are the advantages and disadvantages of packaging ice cream in tubs with circular, rectangular or square bases?

**Discussion structure**

<table>
<thead>
<tr>
<th>General statement:</th>
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<tbody>
<tr>
<td>• state the task</td>
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<tr>
<td>• preview arguments to follow</td>
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</tbody>
</table>

| • Paragraphs on the advantages and disadvantages of packaging ice cream in each type of tub. |
| • Each paragraph begins with a sentence that previews the information in the rest of the paragraph. |

**Recommendation:**
Expert group task

1. Read the information about your shape.
   One student could read the information to the whole group or you may like to
   read it individually.

2. Underline any words you don’t understand.

3. Discuss these underlined words with the group to discover the meanings.

4. Complete the worksheet called “Building Technical Vocabulary about 3D shapes”.
   (Work together as a team.)

5. Now label the picture with the geometrical terms listed on the worksheet.
   (If anyone in your group is having trouble, help them. Don’t forget, this is an
   expert group.)

6. The person with the longest hair in your group needs to collect the model of
   your shape from the teacher NOW.

7. Pass the shape around the group.

8. The tallest person in your group must now collect the equipment needed to build
   a model of your 3D shape.
   The model will be built from straws and connectors. We call this type of model
   a skeletal model.
   Everyone in the group must make a model.
   When you return to your original group you will be the expert on your shape.

9. Congratulations, you are now all experts on this shape and it is time to return
   to your original group to share your expertise.

STOP! WAIT FOR ALL THE OTHER GROUPS TO FINISH. The teacher will
tell you when it is time.

While you are waiting you might like to read through all your information again.
Remember: you are the expert now!
The cylinder

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids, but a cylinder is neither of these.

A cylinder can be open-ended. This means that it has one or two ends opened. Some examples of open-ended cylinders would be a pipe and a can without a lid. An unopened tin is an example of a closed cylinder.

A cylinder has one curved surface. It can also have two flat surfaces if it is a closed cylinder. It has two edges, one goes around the top of the cylinder and one edge goes around the bottom.

The ends of a cylinder are circles that are the same size. If you opened the cylinder out, as in the diagram below, you would see that the curved surface is really a rectangle which has been rolled up.

![Diagram of a cylinder being opened to show the curved surface as a rectangle]

A cylinder has a cross-section which is circular. This means that if a cylinder was sliced, all the slices would be circles, just like slices from a cylindrical loaf of bread.

A cylinder is a solid that will roll and stack easily. Cans are regularly stacked in shops.
The triangular prism

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is named according to the shape of its cross-section.

If the triangular prism is sliced as in the diagram below, then each slice is exactly the same shape and size as the ends of the prism. This shape is called the cross-section. The cross-section of a triangular prism is a triangle.

A triangular prism has two triangular faces. The other three faces are rectangles. Two faces meet at an edge. The triangular prism has nine edges. It has six vertices or corners.

This solid does not roll but it could be stacked if care was taken.
The rectangular prism

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is named according to the shape of its cross-section.

If the rectangular prism is sliced as in the diagram below, then each slice is exactly the same shape and size as the ends of the prism. This shape is called the cross-section. The cross-section of a rectangular prism is a rectangle or a square.

A rectangular prism has six faces. The top and bottom faces are the same size. The left and right hand side faces are the same size, and the front and back faces are the same size.

A special rectangular prism is the cube. It has six faces which are all squares.

Two faces meet at an edge. Three faces meet at a vertex. The rectangular prism has twelve edges. It has eight vertices or corners. Many boxes you see every day are rectangular prisms.

This solid does not roll but it can be stacked easily.
The rectangular pyramid

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A pyramid is a solid with a polygon for a base. All the other faces meet at one point. This point is called the apex (it is also called a vertex).

Because pyramids do not have a cross-section they are named according to the shape of the base. The base of a rectangular pyramid is always a rectangle.

A rectangular pyramid has five faces. Four of the faces are triangles. The other face, the base, is a rectangle.

Two faces meet at an edge. The rectangular pyramid has eight edges. It has five vertices or corners. A rectangular pyramid is not seen often in everyday life – unless you live in Egypt!

This solid does not roll and it does not stack on top of another.
The triangular pyramid

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A pyramid is a solid with a polygon for a base. All the other faces meet at one point. This point is called the apex (it is also called a vertex).

Because pyramids do not have a cross-section they are named according to the shape of the base. The base of a triangular pyramid is always a triangle. Another name for a triangular pyramid is a tetrahedron.

A triangular pyramid has four faces. All of the faces are triangles. Two faces meet at an edge. The triangular pyramid has six edges. It has four vertices or corners. A pyramid is not seen often in everyday life – unless you live in Egypt!

This solid does not roll and it cannot be stacked on top of another.
The cube

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is usually named according to the shape of its cross-section. A cube is a special prism in that it is a regular solid. This means that all of its faces are the same size.

If the cube is sliced as in the diagram below, then each slice is exactly the same shape and size. This shape is called the cross-section. The cross-section of a cube is a square.

A cube has six faces, which are all squares. Two faces meet at an edge. The cube has twelve edges. It has eight vertices or corners. A die is an example of a cube.

This solid does not roll but it can be stacked easily.
Building technical vocabulary about 3D shapes

Complete this table by:

a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.

Find out what these words mean and put this meaning in the table.

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<tbody>
<tr>
<td>corners of the shape</td>
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<td>length, width, depth</td>
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<tr>
<td>shape when you slice it</td>
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</tr>
</tbody>
</table>

Cylinder

Label the parts of the cylinder.

Label the diagram by using these words:

edge  curved surface
flat face  cross-section
Building technical vocabulary about 3D shapes

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Triangular prism

Label the parts of the triangular prism.

Label the diagram by using these words:

- cross-section
- faces
- edges
- vertices
Building technical vocabulary about 3D shapes

Complete this table by:

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Find out what these words mean and put this meaning in the table.

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Rectangular prism

Label the parts of the rectangular prism.

Label the diagram by using these words:

vertices  edges

cross-section  faces
Building technical vocabulary about 3D shapes

Complete this table by:
a) filling in the geometrical terms for the words given
b) adding other geometrical words that you do not understand.

Find out what these words mean and put this meaning in the table.

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<tr>
<td>shape when you slice it</td>
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</tbody>
</table>

Rectangular pyramid

Label the parts of the rectangular pyramid.

- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]

Label the diagram by using these words:

- face
- edges
- vertices
- apex
Building technical vocabulary about 3D shapes

Complete this table by:

a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.

Find out what these words mean and put this meaning in the table.

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</table>

Triangular pyramid

Label the parts of the triangular pyramid.

Label the diagram by using these words:

vertices   edges
apex       face
Building technical vocabulary about 3D shapes

Complete this table by:

a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.

Find out what these words mean and put this meaning in the table.

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<tr>
<td>shape when you slice it</td>
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</tbody>
</table>

Cube

Label the parts of the cube.

Label the diagram by using these words:

vertices edges
cross-section faces
### 3D shapes activity – PMI

<table>
<thead>
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<th><strong>Plus</strong></th>
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<tr>
<td>What did you like?</td>
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</table>

<table>
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<th><strong>Minus</strong></th>
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<tbody>
<tr>
<td>What didn’t you like about this?</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Interesting</strong></th>
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<tbody>
<tr>
<td>What parts of the activity did you find interesting?</td>
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<tr>
<td>What would you like to know more about?</td>
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</table>