hands-on mathematics

Grade 3

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Hands-On Mathematics is arranged in a format that makes it easy for teachers to plan and implement.

Units comprise the selected topics of study for the grade level, organized into lessons. The units relate directly to the learning expectations identified on pages 5 through 11, which are established by the *Ontario Curriculum for Mathematics (2005)*.

The introduction to each unit summarizes the general goals for the unit and provides background information for teachers. Each unit begins with a list of books for students that relate to the unit; a list of related websites (for all units combined) can also be found on pages 120 through 122.

Units are organized into lessons, based on the expectations.

Note: This does not imply that a lesson can be covered in only one lesson period; many will carry over several lesson periods.

The lessons are arranged in the following format:

Background Information for Teachers: Some lessons provide teachers with the basic mathematical knowledge they will need to present the activities. This information is offered in a clear, concise format, and focuses specifically on the topic of study.

Materials: A complete list of materials required to conduct the main activity or activities is provided. It includes classroom materials, equipment, and visuals. The quantity of materials required will depend on how you conduct activities and whether students are working individually or in groups.

Activity/Activities: This section details a step-by-step procedure, including higher-level questioning techniques and suggestions for encouraging active inquiry and discussion.

Activity Sheets: Reproducible activity sheets have been designed to correlate with the specific expectations of the activity or activities. Many of these are used during the activity to record results of investigations. Others are used as follow-up to the in-class activities. Students may work independently on these sheets, in small groups, or you may choose to read through them together and complete them in a large group setting. Activity sheets can also be made into overheads or large experience charts. Since it is also important for students to learn to construct their own charts and recording formats, these activity sheets can be used by the teacher as examples of ways to record and communicate ideas about an activity. Students can then create their own sheets rather than use the ones provided.

Note: Activity sheets are meant to be used only in conjunction with, or as a follow-up to, the hands-on activities. The activity sheets are not intended to be the mathematics lesson in itself or the sole assessment for the lesson.

Problem Solving: Many lessons include suggestions for problem-solving activities that are directly related to the lesson's expectations. These problems may be presented orally, acted out with concrete objects, presented pictorially, or written out on chart paper. At the end of each unit, many of these problems are presented again on black line masters. Teachers can copy these sheets onto overhead transparencies to present to students as daily problem-solving activities. Or, the masters can be copied for students and cut apart, problem by problem. Students can then paste the problems into their math journals or agendas for completion independently.

Activity Centre: Some lessons include independent student activities that focus on the expectations.

Extension: Many lessons include optional activities to extend, enrich, and reinforce the expectations.

Assessment Suggestions: Throughout each unit, several suggestions are made for assessing student learning. Again, these assessment strategies focus specifically on the learning expectations of a particular activity topic. In the next section of the ***Hands-On Mathematics*** program, assessment is dealt with in detail. Keep in mind that the suggestions made within activities are merely ideas to consider; you may use your own assessment techniques or refer to the other assessment strategies on pages 17 and 18.

Classroom Environment

The classroom setting is an important component of the learning process. An active environment – one that gently hums with the purposeful conversations and activities of students – indicates that meaningful learning is taking place. While studying a specific topic, the room should display related objects and materials, student work, pictures and posters, maps, graphs, and charts made during activities, and summary charts of important concepts taught and learned. These reinforce concepts and skills that have been stressed during mathematics activities.

Timelines

No two groups of students will cover topics and material at the same rate. Planning the duration of units is the responsibility of the teacher. In some cases, the activities described will not be completed during one block of time and will have to be carried over. (Division of units into "lessons" does not imply that they can be covered in only one lesson period. Many lessons will, in fact, carry over several lesson periods.) In other cases, you may observe that the students are especially interested in one topic, and you may choose to expand upon it. The individual needs of your students should be considered as there are no strict timelines involved in the ***Hands-On Mathematics*** program. It is important, however, to spend time on every unit in the program so that students focus on all of the expectations established for their grade level.

Classroom Management

Although active learning is emphasized throughout this program, the manner in which these experiences are handled is up to you. In some cases, you may have all students working with materials and resources individually; in others, you may choose to use small group settings. The latter encourages the development of social skills and enables all students to be active in the learning process; it also means less cost in terms of materials and equipment. Again, classroom management is left up to you, since it is the teacher who ultimately determines how the students in his/her care function best in the learning environment.

Planning Guidelines

Mathematics is a skills-based subject. In order to acquire these skills, students need to visit and revisit them over the course of the school year.

Hands-On Mathematics is organized into strand- or topic-focused units. This organization allows teachers to follow the development of concepts from introduction to mastery within a given grade level. To ensure that students have opportunities to develop their mathematical skills in all topics throughout the year, it is recommended that teachers address concepts from each of these units in every reporting period or school term. For example, teachers may choose to begin the year with the unit on Patterns and Relations (Unit 1) but should continue to develop students' skills in this area throughout the entire school year through review, continued practice, and new mathematical challenges. In the same way, although the unit on Number Operations (Unit 6) is presented last in the ***Hands-On Mathematics*** program, students should be provided with opportunities to review, practice, and investigate number operations throughout the school year.

Planning in this way gives students the time needed to solidify their understanding and, at the same time, helps to keep the concepts and vocabulary in the forefront throughout the year.

Note: Developing a year plan will ensure that topics are dealt with throughout the school year. Teachers can design the plan to meet their students' specific needs and fit into their school calendars. On the following two pages, a sample year-plan template is provided. Teachers can use the template to record the skills from each unit that they will teach during each month. There is also additional space for briefly noting other curriculum connections and themes that may relate to the overall math plan. Teachers can divide the bottom row of the chart according to the duration of the curriculum connection and related theme, which may be less than or greater than one month.

Note to Teachers

Hands-On Mathematics, Grade 3 is divided into two parts. Part 1 includes the Introduction to ***Hands-On Mathematics***, Unit 1: Patterning and Algebra, and Unit 2: Data Management and Probability. Part 2 includes Unit 3: Measurement, Unit 4: Geometry and Spatial Sense, Unit 5: Number Concepts, and Unit 6: Number Operations.

5 Identifying the Faces of Geometric Solids (Three-Dimensional Objects)

Background Information for Teachers

In this lesson, students review and/or are introduced to a variety of geometric solids including the sphere, the cylinder, the cone, the cube, the rectangular prism, the triangular prism, the triangle-based pyramid, and the square-based pyramid.

Materials

- two-dimensional shapes (one set, included with lesson 1) (4.1.1)
- pocket chart
- geometric solids (spheres, cylinders, cones, cubes, prisms, pyramids)
- drawing paper
- pencils
- number cubes (you will need one six-sided number cube for each student as well as some other multi-faced number cubes)
- chart paper
- markers
- sorting labels for prisms and pyramids (included. Photocopy, mount onto sturdy tagboard, and cut out.) (4.5.1)

Activity: Part One

Begin the activity by reviewing the names of two-dimensional shapes. In the pocket chart, display the two-dimensional shapes. Point to one of the shapes, and ask:

- What is the name of this two-dimensional shape?
- What makes this shape different from the other two-dimensional shapes?

Repeat the questions for each shape. Then, ask:

- How is a square different from a rectangle?
- How is a pentagon different from a hexagon?
- How is a triangle different from rectangle?

Now, display the geometric solids. Pass them around among students, and allow students time to examine and manipulate each solid. Have students identify any solid with which they are familiar. Ask:

- How are these geometric solids different from the two-dimensional shapes in the pocket chart?
- Do you notice any similarities between the solids and the shapes?
- Can you find some of the shapes on the solids?

Review with students that on a geometric solid, a flat surface is called a *face*. Display one of the geometric solids (other than the sphere), and ask:

- How many faces does this geometric solid have?
- Can you describe the shape of each face? (it is a two-dimensional shape: a circle/square/rectangle/triangle)

Repeat for each of the geometric solids (except the sphere).

Divide the class into working groups, and provide each group with several geometric solids, drawing paper, and pencils. Have students trace the face(s) of each solid onto the paper and record the name of the two-dimensional shape they traced.

Activity: Part Two

Provide each student with a six-sided number cube. Have students examine and describe their cubes. Ask:

- How many different numbers are shown (or represented by dots) on your cube? (6)
- What do we call each flat area that has a number (or dots) on it? (a face)
- How many faces does your number cube have?

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Review that each face of the number cube has a number assigned to it. There are six faces, and, therefore, six numbers, on (or represented on) each number cube.

Display several other multi-faced number cubes. Discuss how the numbers on each cube reflect the number of faces the cube has. A ten-sided number cube has the numbers 1 through 10 on its faces.

Activity: Part Three

Display the geometric solids for students to examine and describe. Discuss the similarities and differences between the solids, focusing on each solid's shape and face(s). On chart paper, record the name of each solid along with the shape(s) of its face(s). Also, record how many faces the solid has. For example:

Solid	Face(s)	Number of Faces
cone	circle	1
cube	squares	6
sphere	—	0
cylinder	circles	2

Students may find it more difficult to identify three-dimensional solids such as prisms and pyramids due to the complexity of their shape and faces. Be sure to spend adequate time focusing on these solids.

Have students sit in a large circle. Place a triangular prism, a rectangular prism, a triangle-based pyramid, and a square-based pyramid in the middle of the circle. Discuss various ways of sorting the geometric solids (for example, prism/pyramid; triangular faces/no triangular faces; rectangular bases/no rectangular bases, and so on). Sort the solids several times based on suggestions from students.

One at a time, hold up each of the four sorting labels for prisms and pyramids (4.5.1), and read the label. Spread out the labels in the middle of the circle. Ask:

- Who can match one of the geometric solids to its label?

Select a student to match a solid and a label. After a correct match has been made, ask:

- How did you know that this geometric solid is a _____ (pyramid/prism)?
- What do all _____ (pyramids/prisms) have in common? How are they all the same? (all pyramids come to a vertex/point at the top; all prisms consist only of faces and do not come to a vertex)

Select another student to match a different geometric solid with its label. Ask:

- How did you know that this geometric solid is a _____ (pyramid/prism)?
- How can we tell the difference between a pyramid and a prism? (a pyramid comes to a vertex at the top; a prism consists only of faces and does not come to a vertex at the top)

Select two students to make the last two matches.

Explain to students that they can differentiate between a triangle-based pyramid and a square-based pyramid by looking at the solid's base. Hold up the triangle-based pyramid, and ask:

- What is the shape of the base on this geometric solid? (triangle)

Say:

- Since the base of this solid is a triangle and all of its edges come to a point (vertex) at the top, this shape is called the triangle-based pyramid.

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Hold up the square-based pyramid. Ask:

- What is the shape of the base on this geometric solid? (square)

Say:

- Since the base of this solid is a square and all of its edges come to a point at the top, this shape is called the square-based pyramid.

Finally, hold up the triangular prism and the rectangular prism. Tell students that they can differentiate between these two prisms by looking at the solid's faces: a triangular prism has both triangular faces and rectangular faces while a rectangular prism has only rectangular faces.

Distribute Activity Sheet A (4.5.2), and have students record the number and shape of faces for each solid.

Activity Sheet A

Directions to students:

For each solid, record the number and shape of its faces (4.5.2).

Problem Solving

Read each of the following riddles, and have students identify the geometric solid described in each one.

- I have six congruent faces, six square faces to be exact. What geometric solid am I? (cube)
- I have five faces. My base is a square. I have four triangular faces. What geometric solid am I? (square-based pyramid)
- I have two faces that are circles. I have two edges but no vertices. I have one curved surface. What geometric solid am I? (cylinder)

Note: Reproducible masters for these problems can be found on page 548.

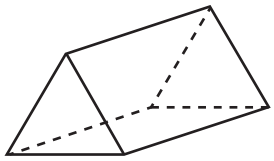
Consider creating more of your own riddles, or challenge students to create their own.

Extensions

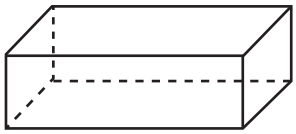
- As required, add the names of the geometric solids to your classroom math word wall.
- Introduce the pentagonal prism, the hexagonal prism and the pentagon-based pyramid. Discuss how these prisms and pyramids get their names by the shape of their bases.

Sorting Labels for Prisms and Pyramids

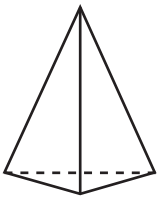
triangular prism



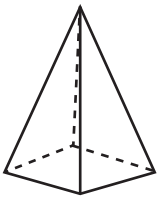
rectangular prism



triangle-based pyramid

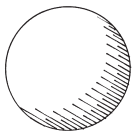
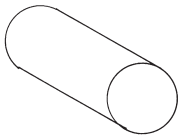
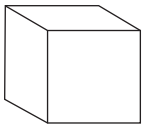
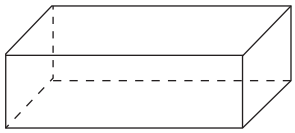
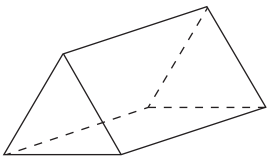
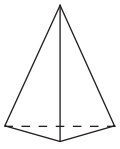


square-based pyramid



Date: _____ **Name:** _____

Three-Dimensional Solids and Two-Dimensional Faces

Solid	Number and Shape of Faces
Sphere 	
Cylinder 	
Cone 	
Cube 	
Rectangular Prism 	
Triangular Prism 	
Triangle-based Pyramid 	
Square-based Pyramid