EXEMPLAR 2:

Ways to Reduce Errors

Objective: To handle and reduce errors in measurement

Key Stage: 3

Learning Unit: Estimation in Measurement

Materials Required: Square grids printed on transparencies

Prerequisite Knowledge: Finding areas of irregular shapes by square grids

Description of the Activity:

1.   The teacher divides students into groups of three and distributes the worksheet to each student. The teacher asks students to find ways to estimate the area of an irregular shape, the Hong Kong Island, printed on the worksheet. Discussion can then be held on their estimates.

2.   The teacher then distributes to each group Square Grid 1 printed on transparencies (Square Grid 1 can be found in the annex) to measure the area of the irregular shape. They have to write down their estimates on the blackboard. The teacher asks each group to explain the difference of the estimates by different groups. Meanwhile, others can make comments.

3.   The teacher then asks students to provide a better way to estimate the area of the irregular shape in order to reduce errors in measurement.

4.   The teacher distributes two more square grids (Square Grid 2 and Square Grid 3 can be found in the annex) printed on transparencies to measure the area of the same irregular shape. Students need to write down their results from the three grids on the worksheet.

5.   Students are led to discuss other factors contributing to errors in measurement such as visual distortions, an inappropriate position in viewing the water level and inappropriate tools such as using a straight ruler to measure the Tuen Mun Road on a map. Discussion on ways to reduce errors in measurement can also be held.

6. The teacher helps students to formulate ways to reduce errors.

7. The teacher guides students to draw final conclusions on other factors contributing to errors.

8. The teacher conducts further activities:

   (a) investigating methods to improve the estimates for the volumes of irregular shapes

   (b) discussing the reasons of using a string instead of a ruler to measure the length of the Tuen Mun Road on a given map and projecting the actual length from this measure (provided that students have the prerequisite knowledge in the concept of ratio and the respective knowledge in map reading)

   (c) studying the past attempts in estimating the radius of the earth (provided that students have prerequisite knowledge in trigonometry) and the ways to find a better estimate

   (d) discussing the problems in estimating the number of influx of mainlanders who have the right of abode in HKSAR and the difficulties in handling the errors in estimation in this case.

   (The teacher should be sufficiently alert not to arouse the special feelings towards certain students in class when this exemplar is adopted.)

Worksheet: Estimation of the Area of the Hong Kong Island

Instructions:

1. Fig. 1 shows an outline figure of the Hong Kong Island.
    Discuss with your group members the way to estimate the area (in cm^2) of Hong Kong Island on the map.
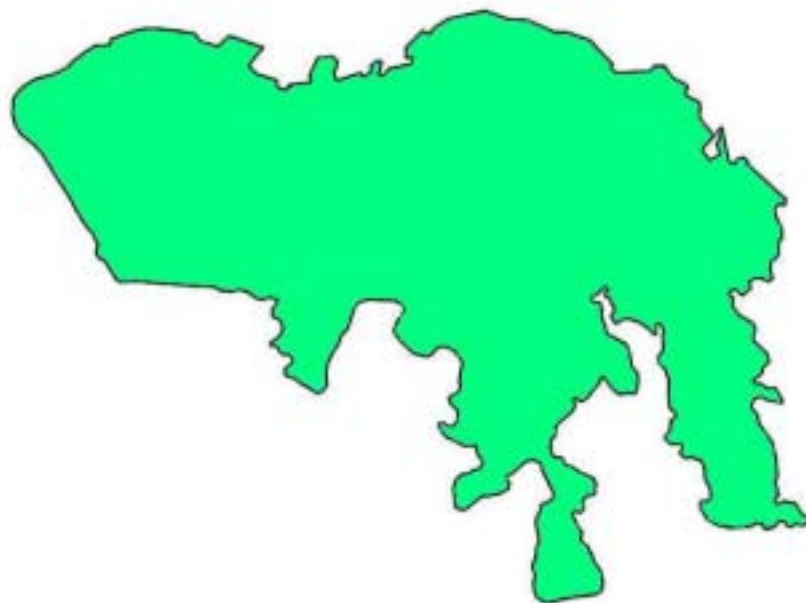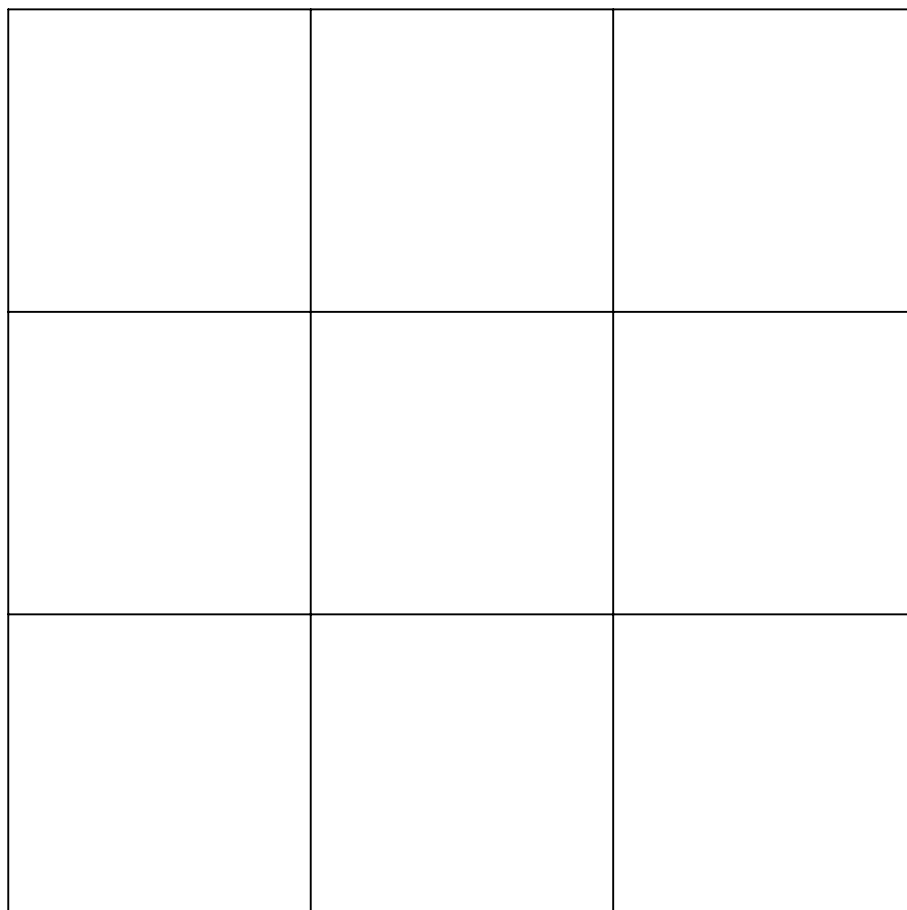

Fig. 1

2. Estimate the area of Hong Kong Island on the map by the instruments given by the teacher. Write down your estimates below.

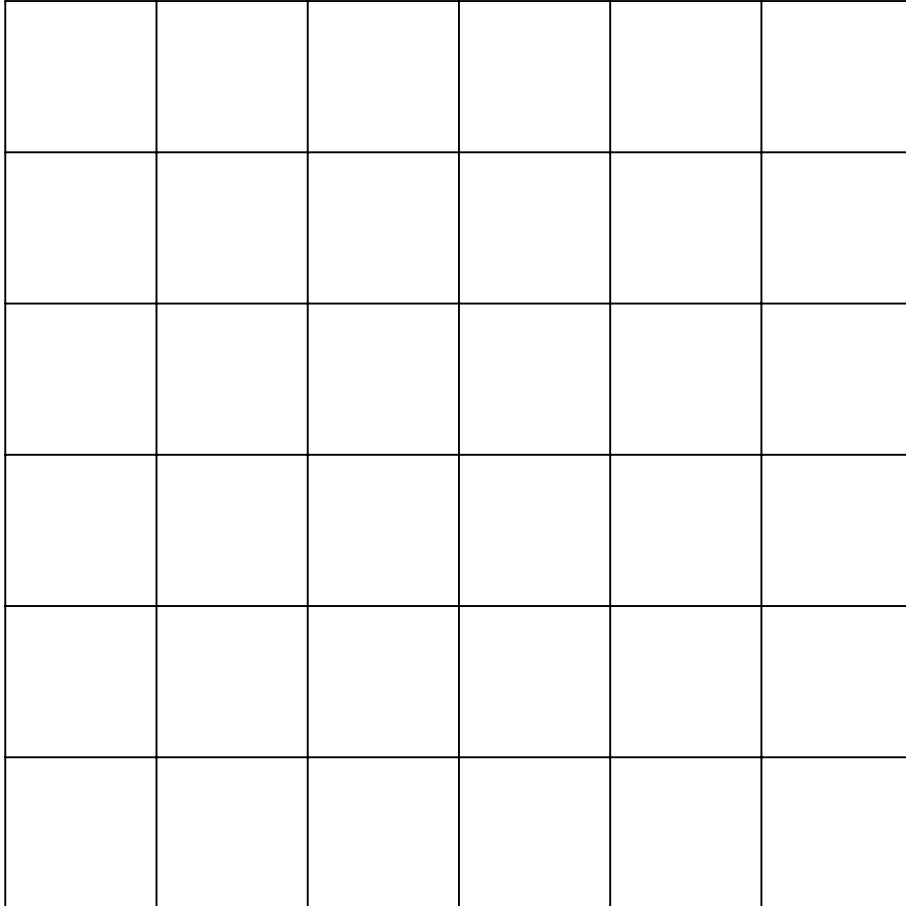   Estimate 1 = _____ cm^2 (By using   )

    Estimate 2 = _____ cm^2 (By using   )
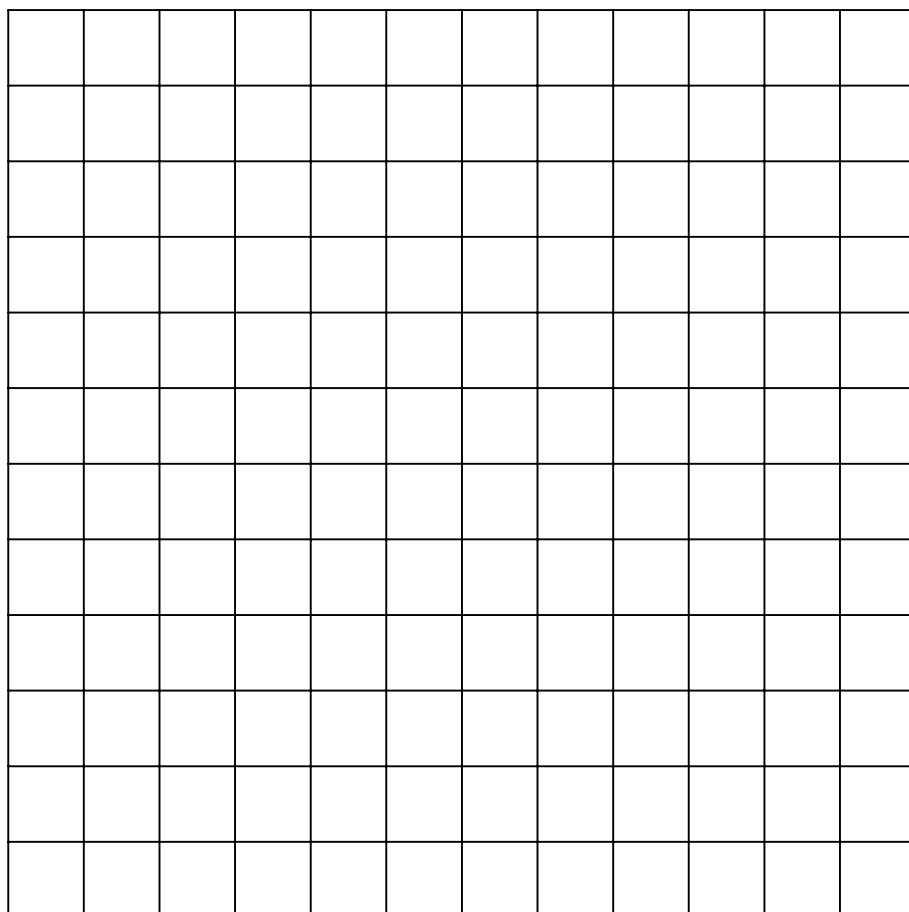
    Estimate 3 = _____ cm^2 (By using   )

Annex

Square Grid 1 (4cm×4cm)

Square Grid 2 (2cm×2cm)

Square Grid 3 (1cm×1cm)

Notes for Teachers:

1. Through this activity, students build up an intuitive idea of finding a better estimate for the areas of irregular shapes and the needs in reducing errors in measurement.

2. In formulating ways to reduce errors, students are guided to use different sizes of grids in measuring the areas of irregular shapes. The teacher can ask students through examples to contribute other methods to reduce errors in measurement. For example:

    (a) by measuring the volume of 1000 drops of water and dividing the answer by 1000 to find the volume of a drop of water;

    (b) by finding the areas of n-sided regular polygons with large n to estimate the value of π.

3. In this activity, the teacher may introduce other factors contributing to errors, such as
    (a) an inappropriate position in viewing the water level;
    (b) inappropriate tools, for example, using a straight ruler to measure the Tuen Mun Road on the map;
    (c) the reaction time in recording the time for a 100m race;
    (d) impossibility in measuring the actual value such as the volume of water in the Plover reservoir;
    (e) the distortion on the visual inspection of the measures of objects, such as from different arrow signs or from different distances to view an object.