

Activities on a Geoboard

the concept of boundary

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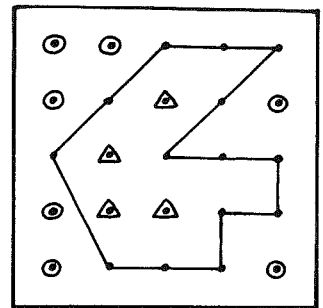
The geoboard is a widely used material of great interest in the teaching of mathematics. Its main quality is that it admits a large variety of activities in which is included almost all the geometry learned in the Primary Schools. Also may be undertaken with a geoboard some non-geometrical topics, such as divisibility, fractions or topology. On the other hand, from the didactical viewpoint, it is amusing for the pupils, they may easily draw perfect geometrical figures and misshape them in order to pass quickly from a shape to another one, all which induces the students to investigate the answers of any proposed problem. Finally, the geoboard is a very cheap material and easy to build even by children.

The aim of this paper is to state a set of activities dealing with the topological concepts of region, boundary, inside and outside, by combining some geometrical and arithmetical aspects of the 5×5 square geoboard. Some activities have been developed by transforming one of the Ideas in Geoboards¹.

First, in activities 1 and 2, we introduce the concepts of inside, outside and boundary of a shape. Afterwards, activity 3 introduces (although not explicitly) the relationship among the number of nails inside, touching the boundary and outside of a shape. They have to add 25 nails as a whole (in a 5×5 geoboard). Activities 4 and 5 also are referred to that relationship; with respect to activity 5, a trial and error technique shows that in a 5×5 geoboard there is not any triangle with 8 nails inside. Here arises a question for gifted pupils: Is there a proof of this fact, other than the exhaustive building of triangles? (think in Pick's rule.). Lastly, the activity 6, if realized several times with different quantities of nails, gives explicitly that relationship.

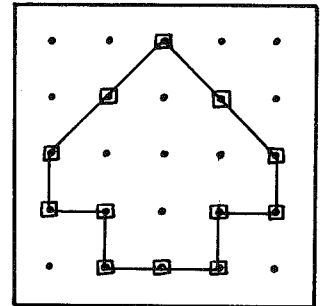
Activity 1

Look at the figure on the geoboard. There are 4 nails inside the figure and there are 7 nails outside the figure. Build on your geoboard a figure with 5 nails inside and 8 nails outside.



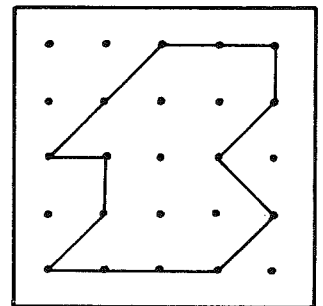
Activity 2

The figure on the geoboard has 5 nails inside and 12 nails touching its boundary. Build on your geoboard a figure with 1 nail inside and 7 nails touching the boundary.

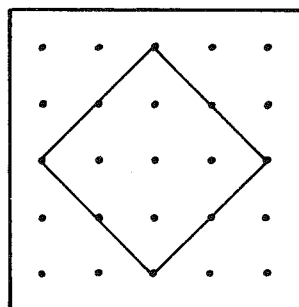


Activity 3

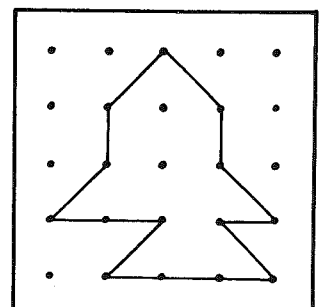
The figure on the geoboard may be described by $B(14)$, $I(5)$. This means that the figure has 14 nails touching the Boundary and 5 nails Inside.



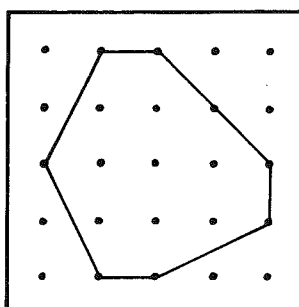
Which numbers describe the following figures?



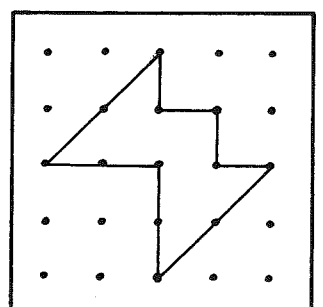
$B()$, $I()$



$B()$, $I()$



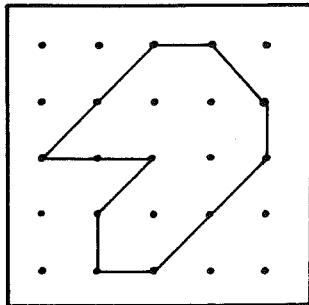
$B()$, $I()$



$B()$, $I()$

Activity 4

The figure on the geoboard is $B(12), I(4)$. Are you able to build some different figures also described by $B(12), I(4)$?



Activity 5

Are you able to build figures described by the following numbers?

$B(6), I(4)$ $B(4), I(6)$ $B(4), I(8)$ $B(3), I(8)$

Activity 6

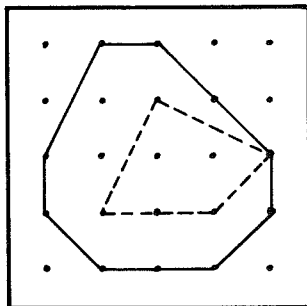
Build on your geoboard a figure with 6 nails outside and 3 nails inside. How many nails touch the boundary?

It is important for the students to realize that the concepts of inside and outside are relative; with activities 7 and 8 the pupils will observe such characteristic.

Activity 7

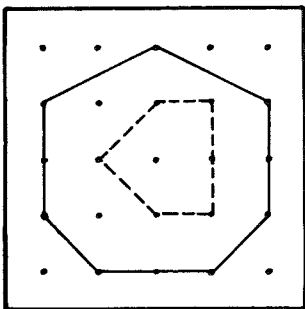
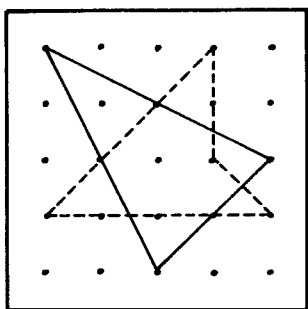
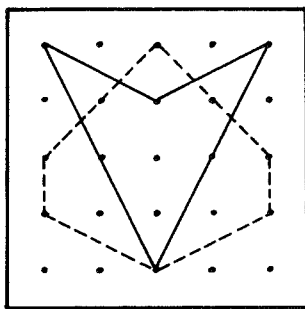
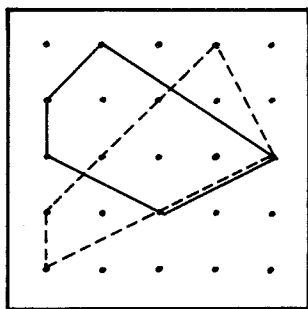
Build on your geoboard the figures that you see on the right hand. Point out with your finger a nail on the geoboard and tell if it is inside or outside the figures.

Repeat the activity with some nails.



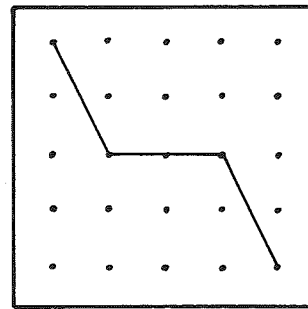
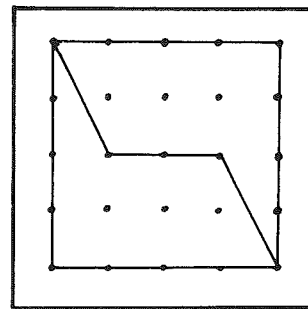
Activity 8

Repeat the last activity with the following pair of figures.



The last part of activities (from 9 to 15) is oriented to working with boundaries between open regions of the geoboard, for which reason also the boundaries are open lines. So we avoid that students associate the concept of boundary with that of closed line.

The youngest pupils may find difficulty in dividing the geoboard in equally shaped parts; a reason is the absence of limits in the geoboard, since students are accustomed to compare the shape of limited figures (polygons, objects, etc.). A way for helping them to overcome this difficulty is by surrounding the geoboard with a rubber band (figure 13).

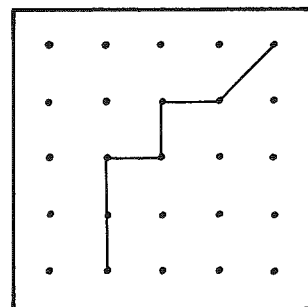


When a geoboard is divided into three (or four) regions, then two, three (or four) boundaries appear, in spite of only two rubber bands being used. It is useful to insist on it during the realization of activities 11 to 15, although activity 14 is explicit enough when asking the pupils if a nail belongs to one, two or more boundaries.

The activity 12 has the difficulty that a 5×5 geoboard cannot be divided into three equally shaped regions; a possible solution is to eliminate a unit square in order to work on a surface of 15 units. Another possibility is to use another size of geoboard; the best one is the 7×7 geoboard, because it may be divided into two, three or four equally shaped parts.

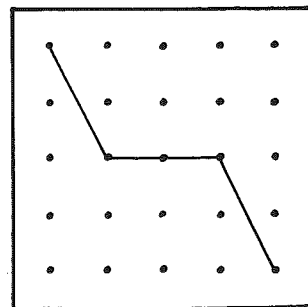
Activity 9

Divide your geoboard with a rubber band in two regions with the same numbers of nails in each one (look at the figure). How many nails touch the boundary?



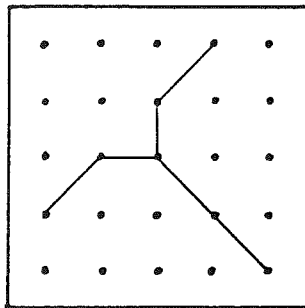
Activity 10

Now divide your geoboard with a rubber band in two equally shaped regions (as in the figure). How many nails touch the boundary?



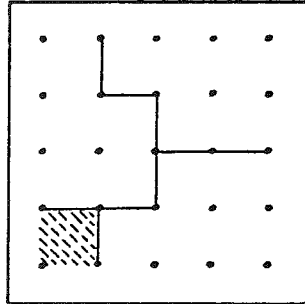
Activity 11

Divide your geoboard with two rubber bands in three regions with the same number of nails in each one (as in the figure). How many nails touch the boundaries?



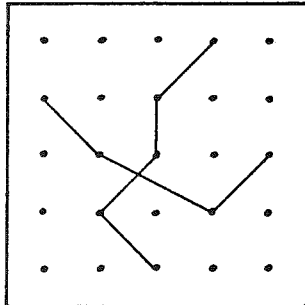
Activity 12

Divide your geoboard with two rubber bands in three equally shaped regions (look at the figure). How many nails touch every boundary?



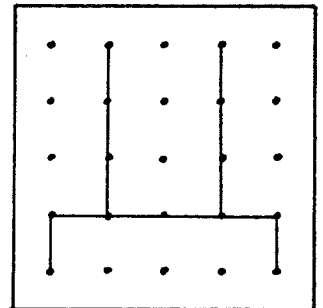
Activity 13

Divide your geoboard with two rubber bands in four regions with the same number of nails in each one (as in the figure). How many boundaries are there on the geoboard? How many nails touch every boundary?



Activity 14

Divide your geoboard with rubber bands in four regions with the same number of nails in each one. Is there some nail touching different boundaries? Repeat the construction with some nails in that way (look at the figure). How many nails are there in each of the four regions? How many nails touch each boundary? How many nails touch more than one boundary?



Activity 15

Repeat activity 14 but dividing the geoboard in four equally shaped regions.

Pupils will repeat these activities several times with different partitions. Teachers who like using a variety of materials may repeat some of these activities, that students have realized on the geoboard, translated to a geographic chart, in which students may observe the boundaries between the countries. Some of them are open boundaries, others are closed, on some places met two or three boundaries, etc.

Reference

1. Assoc. of Teachers of Maths. (1978) *A collection of Ideas about Geoboards*, A.T.M.: Nelson, Lancs.

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11-16

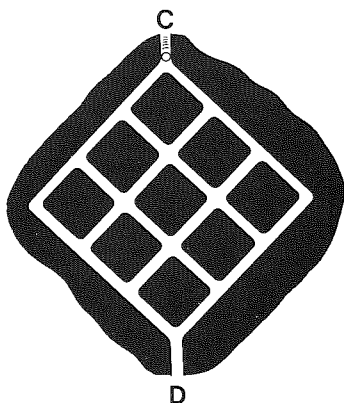
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How many different ways are there of falling from C to D?