

Design your city block

<p>Respective blueprint</p>	<p>Groma- Roman measurement tool</p>
<p>Description</p>	<p>Students will learn the history of the Groma and will learn how to use it for surveying purposes. This includes how to create a straight line and a 90-degree angle, so that they can then design a city block with several elements, such as cross-streets, a new building, etc.</p>
<p>Learning Objectives</p>	<ol style="list-style-type: none"> 1. Learn the history, origins, and use of the Groma. 2. Learn how to create a straight line and a 90-degree angle at a distance (in large outdoor spaces) to design different elements in an open space.

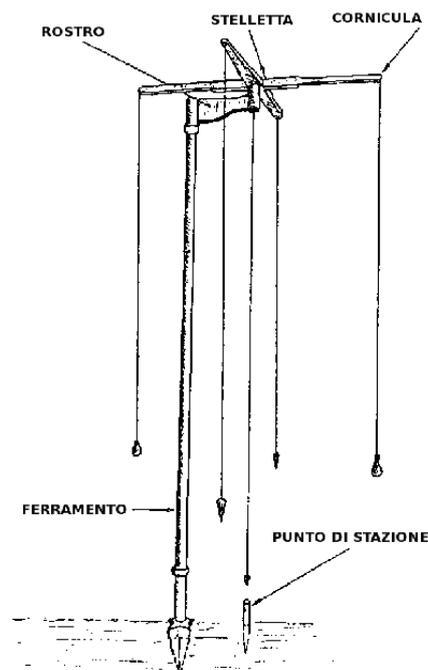
<p>Related curricular subject(s)</p>	<p>History, Geometry, Environmental Studies</p>
<p>Prerequisites / preparatory actions for teachers</p>	<p>Minimal research on the Groma (links provided + additional research if desired).</p> <p>Teachers should also gather materials for the Groma blueprint.</p> <p>Additional materials needed for the sequence:</p> <p>If in a grassy area:</p> <ul style="list-style-type: none"> ● Several large rolls of surveyor's tape (or caution tape, ribbon, or other flexible measuring material that comes in a large quantity) in different colors (if possible) to denote different areas. ● Dowel rods or wooden sticks to place in the ground to mark the limits of the elements surveyed.

	<p>If in a paved/patio area:</p> <ul style="list-style-type: none"> • Chalk, in several colors • (Optional) Cones to mark different points where wooden sticks would have been placed in the ground. • One wooden pole for sighting
<p>Prerequisites / preparatory actions for students</p>	<p>Basic geometry knowledge (different types of angles and other terminology).</p>
<p>Age of students</p>	<p>10-18 years old</p>
<p>Duration</p>	<p>3-3.5 hours</p>
<p>Level of difficulty</p>	<p>Easy to medium, depending on the age and skill levels of students, and how extensively they decide to survey their city block.</p>

Step by step description of the tasks

Step 1. Historical introduction to the Groma (classroom, 30 minutes)

The Groma was a tool used by ancient Romans for surveying land in straight lines and right angles. Thus, it was especially useful for surveying the construction of new towns or cities, roads between settlements, agricultural lands, military forts, public services, etc.



Source: Rainiero, 2006.

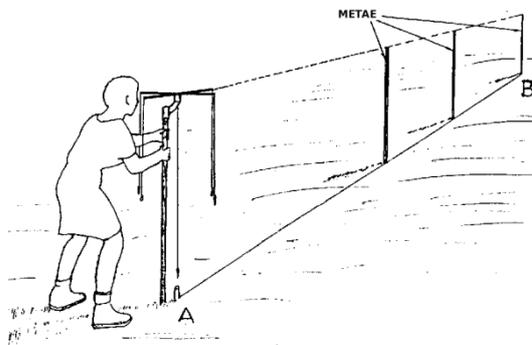
The Groma is made up of the following pieces (as seen above):

- The Upright (*Ferramento*): a vertical staff or pole measuring 1.5-2m, with a metal tip at the bottom, for sticking into the ground



- The Rostro: a right-angled extension fixed to the top of the Upright with a swivel mount, able to rotate horizontally 360 degrees. The Groma's center point was attached to the top of the Rostro, and a plumb line (a line with a weight) was fixed below the Groma's mounting point.
- The Groma (*Stelletta*): a wooden cross made with arms of equal length. Four plumb lines of equal length hung from each of the four arms of the Groma (*cornicula*).
- The Marker Peg (*Punto di stazione*): a wooden peg stuck in the ground beneath the center point of the Groma, to mark the starting point of measurement.

Using the Groma



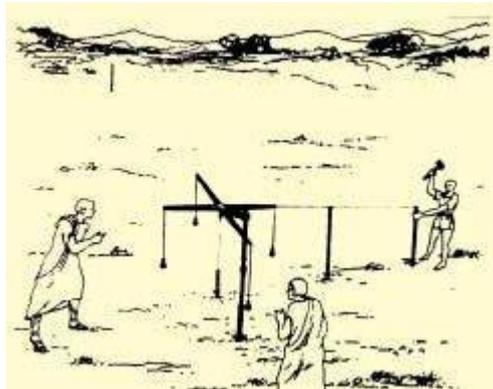
Source: Rainiero, 2006.

In order to use the Groma, a surveyor would find a suitable starting point (usually on higher ground) and stick the Upright into the ground to stabilize the tool. Next, the Rostro and the Groma were spun and pointed in the direction the tool was going to be used. A helper would



walk a good distance (usually 100-125 steps) and place a pole provisionally. The surveyor would then guide the helper to move his pole left or right as needed, so that the pole was in line with the 3 strings of the Groma: the North and South plumb lines and the middle plumb line. When the pole was finally lined up with these three strings, the helper would stick the pole into the ground.

This process could be repeated as many times as necessary to obtain straight lines over long distances, though there was often a margin of error due to the sighting involved.



Source: Rainiero, 2006.

To measure a right angle, a second helper could stand at a distance in line with the East-West axis of the Groma, and the surveyor could signal this straight line after setting the North-South straight line.

Sources & more information:

[\(H2G2, 2016\)](#), [\(Rainiero, 2006\)](#), [\(Wikipedia, 2021\)](#)

Step 2. Building the Groma (classroom, 100 minutes)

Using the corresponding Groma blueprint, you may dedicate 1 to 1.5 class sessions to building the Groma with your students.

It will take approximately 1.5 to 2 hours to build.

Step 3. Designing your city (outdoor activity, 60 minutes)

Once the Groma is built, the students can put their creation to use by surveying the beginning of their own city in an outdoor area near the school.

If you are able to access a park or another spacious, grassy outdoor area, make sure to bring the following materials for this step:

- Several rolls of colored surveyor's tape (often sold at hardware stores) or another kind of flexible material for measuring
- Dowel rods or other wooden sticks that may be stuck in the ground and have the tape tied to them

If you will carry out this activity in the school patio or another paved surface, you may also choose to use tape and weigh it down with rocks or other suitably heavy materials, or you may bring the following materials:

- Chalk, in several colors
- (Optional): Cones to mark different points where wooden sticks would have been placed in the ground.
- One wooden pole for sighting

First, you (the educator) should demonstrate to the class how to use the Groma, with the help of several students.

You can start by modeling **how to use the Groma to measure a straight line**:

- Select one student to place the Upright into the ground (or hold it in place above the pavement) and a second student to set the Marking Peg.
- Select a third student to be the helper, who will walk approximately 100 steps (or as many steps as you have space to walk) and carry a pole for sighting.
- The first student who placed the Upright should spin the Rostro so that it is pointing in the direction of the straight line they want to measure.
- Next, they should align one arm of the Groma with the Rostro, so that all three strings of the North, South, and middle plumb lines form a straight line.
- They should call out adjustments to the helper, who can move from side to side until the pole they are carrying is in line with the three strings.
- When the straight line is set, the helper either sticks the pole into the ground or marks its position with chalk.

- The student who set the Marker Peg or a fourth student may be placed in charge of running a line of tape or drawing a chalk line from the original Marker Peg to the newly placed pole.

Once students have understood this procedure, you can model **how to survey a 90-degree angle**.

- With the Upright still in place and the Rostro and Groma still facing the straight line you have just found running North-South, ask another student to act as a helper along the East-West axis.
- This student should also take approximately 100 steps (or as far as they have space to walk) to the East or West of the tool.
- Without moving the Groma's position, the student at the Upright should position themselves so that they see the three strings of the East, West, and middle plumb lines in a straight line.
- Next, they should call out directions to the helper, who will move with the pole until they are directly in line with the three strings on the East-West axis, and then place the pole in the ground or mark the position with chalk.
- Another student may run a line of tape or chalk from the Marker Peg to this new point.
- Finally, you can point out the shape of the 90-degree angle to your students and ask them whether they think it is more or less efficient to survey using the 90-degree angle (rather than setting up the Groma twice to make two straight lines). In which cases?

Once you are confident that students have mastered the basics, they may begin to **plan their city block in more depth.**

Under your supervision, students should be divided into groups of four or five and take turns to complete the square or rectangle that forms the city block, and then survey different elements that might be included in a real city block.

This “city planning” will depend greatly on the materials, time, and open space available to you. However, it would be useful to measure and mark out the full city block and the cross-streets surrounding it, taking care to mark these areas so it is easy to see where their boundaries lie. If you can mark these elements in different colors to differentiate their uses, even better!

Afterward, depending on the time and space available, students can begin to measure and signpost the spaces where one or more buildings will go in their city block, inventing the names and uses of these buildings to make it more fun and creative. If there is extra time, they can think about additional elements of a city block that they might like to measure and signpost, such as alleyways, parking spaces, public parks, private gardens, etc.

Make sure to take photos during the exercise and when students have finished surveying their city block, so that they can remember the experience!

Assessment activities

After completing the outdoor portion of the lesson, students may continue thinking about how to survey a city block, either in another classroom session or for homework.

Ask students to remember their experience of creating the city block using the Groma. Keeping this procedure in mind, they should **draw their own 2-D maps that incorporate at least 2 city blocks.**

In this task, they should think about how the space will be laid out (in each block and between the two blocks), what kind of buildings will be placed there, and what other kinds of urban elements they would like to include (for example: streets, alleyways, parking lots, public parks, private gardens, sidewalks, etc.). They should also reflect on which kinds of spaces may be measured by the Groma (i.e. in straight and right angles), and which cannot.

If you do this activity in class, you can reserve some time for students to share their maps and have a general discussion of the work that goes into designing, surveying, and building a city. This discussion is a good chance to process their experience of surveying in a group using the Groma, as well as their individual experiences of planning their maps.

- Do they think it is easy to plan for bringing new buildings and public spaces to life?
- Did they experience any conflicts in how to use or measure the space?
- How precise do they think the Groma was?

- How do they think surveyors and planners might plan spaces that use acute or obtuse angles of varying degrees?
- Do they know which tools are used for surveying today?

References

H2G2. (2016). The Groma: The Tool that Built an Empire. *The Hitchhiker's Guide to the Galaxy: Earth Edition*. Retrieved from:

https://web.archive.org/web/20161220231445/http://h2g2.com/edited_entry/A24591099

Rainiero, N. (2006). How to Use the Roman Groma. *De Legione Romana*.

Retrieved from: <https://legioneromana.altervista.org/content/how-use-roman-groma?language=en>

Wikipedia. (2021). Groma (surveying). *Wikipedia*. Retrieved from:

[https://en.wikipedia.org/wiki/Groma_\(surveying\)](https://en.wikipedia.org/wiki/Groma_(surveying))