

Title: Where am I?

Educational level: Third Cycle of Primary Education

Curricular Areas: Mathematics.

Timing: Two sessions (45 + 45 min).



Brief description of the activity

This activity is aimed at understanding how geolocation and positioning systems work. It can be carried out in teams of four people: one person (X) is the one who is going to be located on a plane, for example, on the basketball court, and the other three people will form the reference system (A, B, C).

This is a simplification in terms of the operation of global positioning systems in space (American GPS, Russian GLONASS or European Galileo).



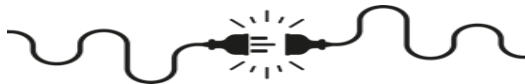
Goals



- Understand the operation of localisation and positioning systems on plans and maps based on reference points.
- Use appropriate instruments, techniques and units to measure lengths.
- Follow a strategy to apply a simple representation system in the plane, which can be later extrapolated to positioning in space and used in computational systems.

Key competencies to develop: personal, social and learning to learn skills, mathematical, scientific and technological skills, digital competence and entrepreneurial skills.





How do we do it?

Preparation

1. Divide the class into groups of 4 people.
2. In each group, one person (X) will be the one to be located on the map and will be located anywhere in the chosen space, for example, the basketball court.
3. The other three people from each group (A, B, C) will form the reference system, one on the left basket post (A), one on the right basket post (B) and one on the wing at the height of the centre of the field (C).

Field work

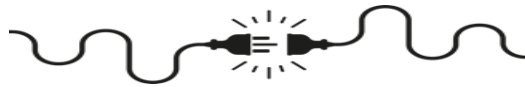
4. Each of the three people in the reference system will measure how far they are from the person to be located (AX, BX, CX). It can be measured by counting steps if you do not have a long tape measure (every four steps can be considered one metre).
5. Group members then represent the situation on the court paper template, positioning the three people (A, B, C) who form the reference system.
6. With a compass and centre at the reference points (A, B, C), arcs of circumference are drawn with the radius of the measured distances (AX, BX, CX). To make the representation to scale on paper, you must take 1 centimetre by 1 metre.
7. In this way, a single point of intersection of the three arcs of circumference will be determined, which will indicate the exact location of the person (X) on the basketball court.

Conclusion

A group reflection is proposed in which the students will be able to draw these conclusions:

8. With a single reference point (A) and knowing the distance to the person to be located (X), it could be at any of the points on the circumference at that distance (AX).
9. With two reference points (A, B), the person to be located (X) could be at one of the two intersection points of the two circles at those distances (AX, BX).
10. Generalising, three reference points (A, B, C) are required to determine the position of another point (X) in the plane from the intersection of the three circles that define the distances between the point and the references (AX, BX, CX). This method of geolocation is called triangulation.
11. Extrapolating, to locate a point (X) in three-dimensional space in a unique way, four reference points (A, B, C, D) are required, thus, the position is determined by the intersection of the spheres centred on the points of reference and radius the distances between the point and the references (AX, BX, CX, DX).





Suggestions

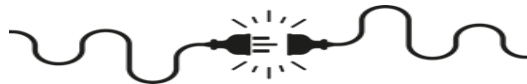
At the end of the activity, the operation of the GPS system can be presented and explained (*Global Positioning System*) to expand the scope of the activity.

As a recommendation, you can use the NASA video [How Does GPS Work?](#), for better comprehension, you can activate subtitles.



Some relevant data from the GPS system	<ul style="list-style-type: none"> • It has 24 geostationary satellites as a position reference for the entire earth. • The satellites are 20,350 km away (the moon is approximately 384,400 km away). • The satellites synchronise the exact time with each other. • Each satellite calculates its distance to a user by the delay suffered by the echo of the electromagnetic waves it emits.
Some questions about the GPS for students	<ul style="list-style-type: none"> • What does geostationary mean? • What is geolocation used for today? • How fast do electromagnetic waves travel? • Why is it important for GPS satellites to synchronise time? • GPS is a US system, do you know if there are others?





Resources

- **Personal:** teachers and students.
- **Materials:** worksheet, long tape measure, pencil and compass.



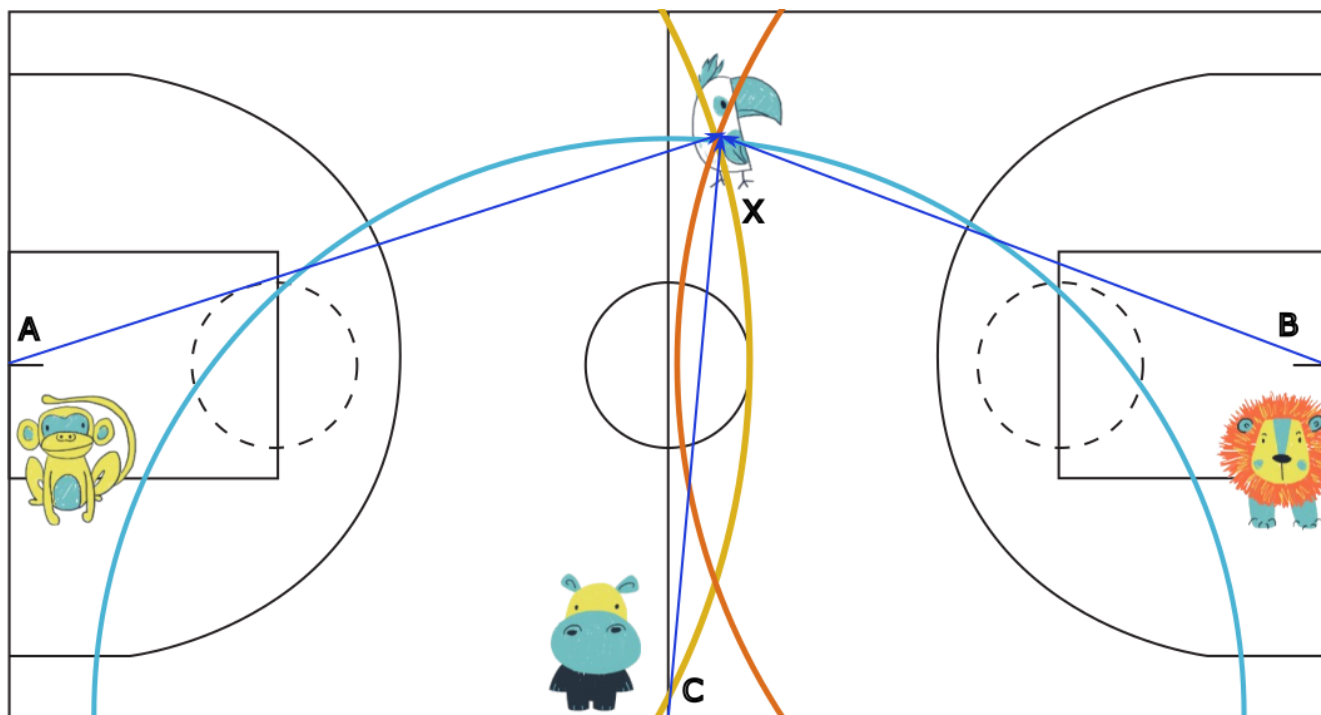
Spaces: group classroom and basketball court.

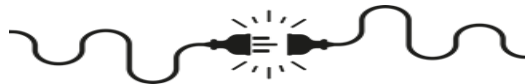
Type of activity: activity in small groups of 4.



[Data collection sheet \(.pdf\)](#)

[Editable plan of a basketball court \(.svg\)](#)

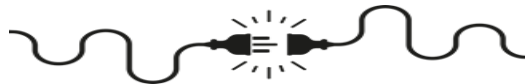




What have we learned?

Rubric for grading the activity:

Evaluation Criteria	High level	Moderate level	Low level	Minimal level
Collaborate with the work team, reach agreements and coordinate the completion of tasks	Collaborates with the group, carrying out tasks in a coordinated manner.	Performs the necessary tasks, but lacks coordination with the group.	Collaborates little with the group, does not coordinate and leaves tasks undone.	Does not collaborate with the group and does not perform the necessary tasks.
Take measurements correctly in field work	The measurements are precise and correct.	There is one incorrect measurement.	There are several incorrect measurements.	All measurements are incorrect.
Complete and correctly present the data collection and layout sheet	The measurements have been carried out well on paper and the arcs intersect at the requested point.	Some measurement or some arc has not been drawn well and there is an inaccuracy.	Several measurements and arcs have not been drawn well and the error is large.	All measurements and arcs are incorrect and do not intersect at the point.
Understand the method to determine the position of a point in the plane	Completely understands the method to find the position of a point on the plane.	Follows the method well, but there are some steps performed without understanding them.	Follows the method, but does not understand the purpose of what we are doing.	Does not follow the method, does not understand the purpose of the procedure carried out.



Computational thinking

Logic (prediction and analysis): use reasoning to make predictions, solve problems, and make decisions based on available information.

Algorithms (steps and rules): follow a series of well-defined steps or instructions to solve a problem or complete a task.

Decomposition (divide into parts): Breaking down a large problem into smaller, more manageable parts, which are easier to understand and solve.

Patterns (detect and use similarities): identify similarities or patterns in problems or data, making it easier to find faster and more efficient solutions.

Abstraction (removing unnecessary details): Simplify a problem by eliminating details that are not important, to focus on what is relevant and essential.



More information

QR codes linked to the activity resources



QR - data collection sheet



QR - Basketball court plan