Hamilton in Europe

Materials

A double DINA3 board, in solid PVC.

The bottom sheet is whole and serves as a support.

A second layer must be glued on top, made with holes in the place where we want to locate the 10 destinations of our tour. In these holes will be placed the small neodymium magnets, glued to the bottom sheet.

A vinyl or a laminated cardboard with the reproduction of the map of Europe with the 10 cities marked will be stuck on top (the 5 of the project partners plus others to choose from friends and families).

The route between the cities is achieved with a thin iron chain.

Brief description

The goal of the activity is to find the shortest route between the cities indicated on the map, starting and ending the route from a freely chosen city. The length of the chain (abundant, sufficient or scarce) allows us a first verification of the proposed solution.

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Assembly

Design of all the pieces

The Board (DINA3)

You can replace the magnets with small pegs glued in correspondence of the ten cities, obtaining a kind of geoboard. Instead of the chain, you can use a non-elastic cord to join the cities.

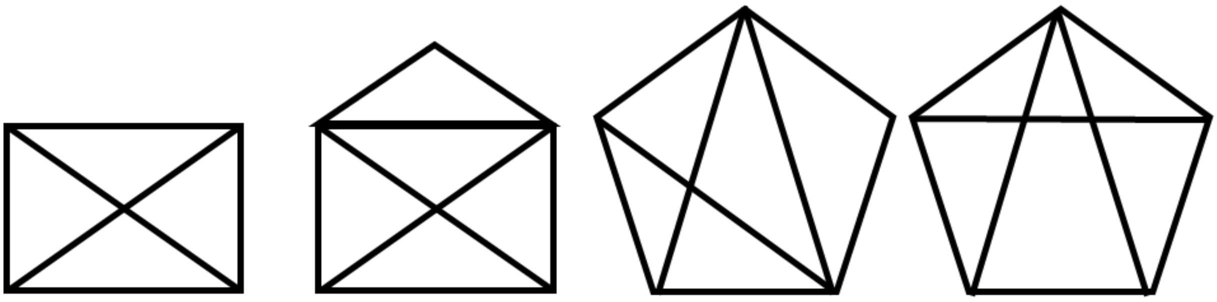
Another variation is to put adhesive Velcro spots (rough surface) to cover the cities we want to connect using a thin wire made of wool.

Other Options

Especially if we want to transform this module into a laboratory activity, partially guided, there is a program made in GeoGebra that allows you to build Hamiltonian paths by choosing the points to join.
[(https://twitter.com/MathTechCoach/status/1527976875364175872?t=cC3OmoCzmxq1SrJPWz890g&s=09)](https://twitter.com/MathTechCoach/status/1527976875364175872?t=cC3OmoCzmxq1SrJPWz890g&s=09)

This would allow for building different paths and verifying their optimization.

An interesting enrichment activity could be comparing the Hamiltonian paths with those of Euler (the Konigsberg bridges), joining the points of a path with a pencil stroke without passing the same stretch twice. Some of these exercises represent well-known challenges, such as the closed and open envelope.



For higher school grades, the goal of formulating the algorithm that allows you to establish which paths are viable and which are not, can be proposed.

Explanation

The paths of Hamilton and Euler, while both belonging to the field of Graph Theory, represent very different problems. In this sense, if for the Eulerian paths there is an algorithm that allows to know, without proving, if a path is viable or not, for the Hamiltonian paths this algorithm does not exist, and they represent a type of NP-complete problems.

Competences

It's a classic exercise in practising a trial-and-error methodology.

Grading the difficulty of the subsequent proposals, we stimulate the elaboration of strategies that arise from observation and from deriving some patterns.

Observations

Any observation to be explained regarding the exhibit, its functioning and assembly.

For 3d Printers (If applicable)

Small-scale structures, based on the "geoboard" model, without magnets, can be built with a 3D printer, especially if aimed at researching the characteristics of Hamiltonian and Eulerian paths.

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