LESSON SCENARIO 01: GRAPH THEORY

Topic: Graph in maths

Level: Age 14 -18

Foreknowledge: Knowledge of EU countries

Correlation: Geography, social sciences and economics

LEARNING OUTCOMES

- Know the vocabulary related to graphs
- Model a map
- Solve a graph

TEACHING METHODS

- Practical work
- Hands-on activity

KEY WORDS

- Graph
- EU
- Edge
- Vertice

RESOURCES

- Coloured pencils
- Eraser

INTRODUCTION TO THE NOTION OF GRAPH (20 MIN)

EXERCISE 1:

The teacher explains the definition of a graph and its vocabulary.

What is a graph?

Students can respond by talking about a diagram... The teacher should explain what a graph is in mathematics.

In mathematics, and more specifically in graph theory, a graph is a schema containing points called vertices, connected or not by segments called edges.

In the exercise, A is a vertice, the segment [ab] is an edge connecting a to b (or b to c). D is an isolated vertex, not connected to another vertex.

A discussion can follow on concrete cases of the use of graphs in daily life.

Computer, Family tree, metro map....

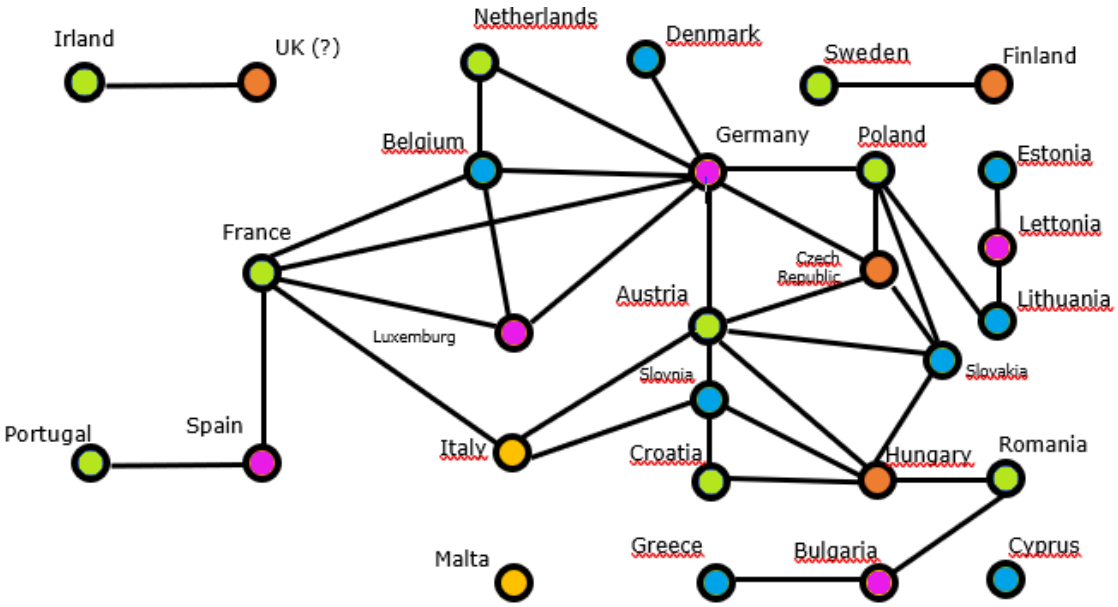
There are currently several types of applications, but the main one can be found in computer science. Graphs are a mathematical structure that is particularly well suited to computers: they serve as a data structure, i.e. they make it possible to organize sets of objects (names, numbers, sequences of operations, etc.) in a way that is simple and practical to use.

<u>Worksheet for students:</u>

Teachers can discuss about the historical theme.

In 1852, Francis Guthrie, an English cartographer, discovered that it only took four colours to colour the map of the cantons of England so that two neighbouring cantons would not be the same colour. After many episodes, and more than 120 years later, two American mathematicians provided a mathematical proof thanks to the demonstration of the *4-colour theorem* which states that "whatever the complexity of a geographical map, four colours are sufficient to colour it without two border regions being the same colour".

For the first time, a computer was used to complete a demonstration.



Then the teacher gives instructions on what to do:

Colour each vertex of the graph with a colour, 2 vertices connected by an edge must be of different colour.

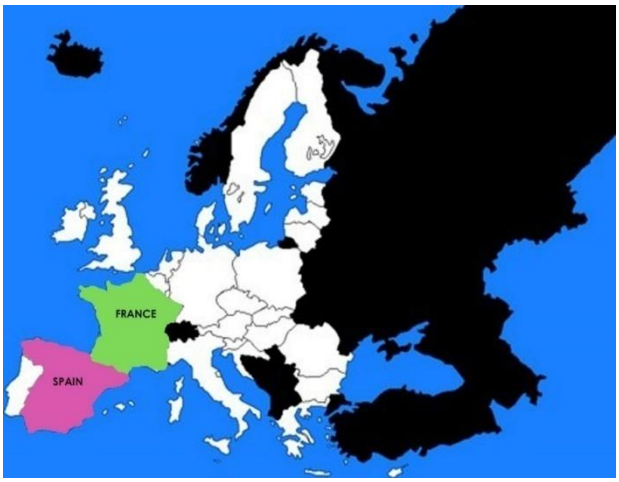
He supervises the classroom and notices various ideas that students have explored and written down.

THE MAIN PART (20 MIN)

EXERCISE 2:

The teacher divides the students into groups of 2. Then he/she gives instructions on what to do:

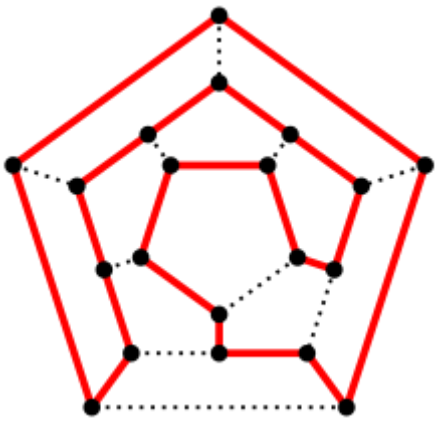
Place the names of the countries on the map and colour the map of Europe, from 4 different colours. Bordering territories must not be the same colour.



He/she can go further concerning graphs: their orientations, Euler or Hamilton graphs…

A distinction is made between non-oriented graphs, where the edges connect two vertices symmetrically, and oriented graphs, where the edges, then called arrows, connect two vertices asymmetrically.

A Hamiltonian trail or path is a trail in the graph that passes through every vertice once and only once. A hamiltonian cycle is a hamiltonian trail which is a cycle, i.e. a closed trail. A hamiltonian graph is a graph that has a hamiltonian cycle.



Like all Platonic solids, the dodecahedron is represented by a Hamiltonian graph.

An Eulerian trail or path is a trail in the graph that passes through every edge just once. If the trail is closed, it is an Eulerian cycle. A graph is said Eulerian if it has an Eulerian cycle.

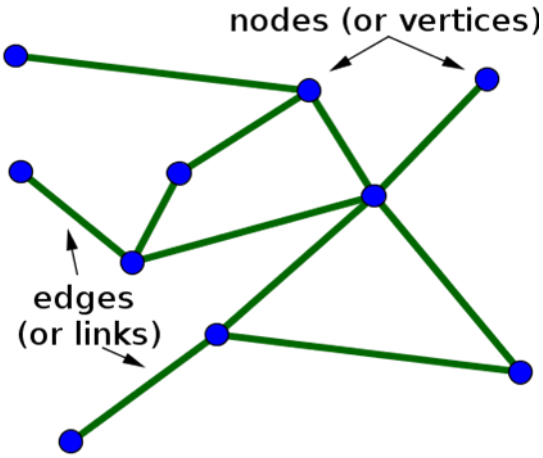
A graph can be Eulerian, Hamiltonian, both at the same time, or neither.

EVALUATION

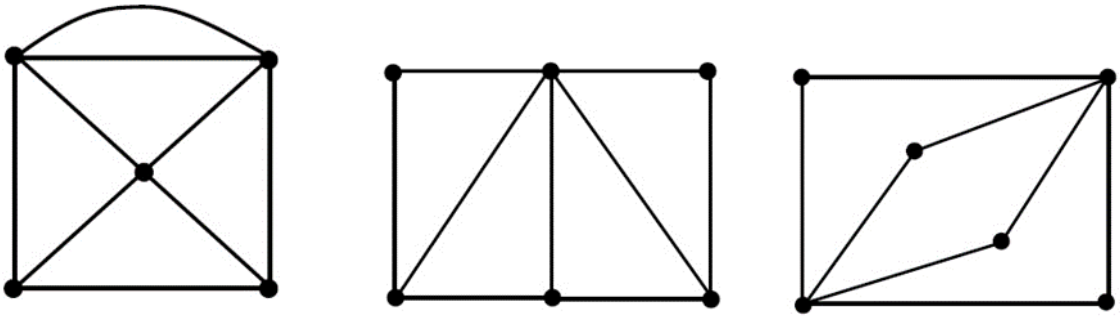
FINAL PART (5 MIN)

1. Do I know what a graph is? Can I build one?

Draw a graph and write the names of its elements.



2. Is the following graph Hamiltonian or Eulerian or both?



1: Eulerian

2: Hamiltonian and non-Eulerian

3: Eulerian and non-Hamiltonian

INCLUSIVENESS GUIDELINES

Every student is different and their needs for the material might vary. Below you will find several tips that could make mathematics lesson more inclusive for students who struggle with learning disorders.

- **When giving assignments to classroom try to break them into small pieces of information. Avoid the double tasks in the instructions. Remember that in case of operations/exercises with multiple steps, it is critical to help learners decompose the steps.**
- **You can use checklists for your students to make sure they have done all the steps**
- **Make sure the font, line spacing, and alignment of your document is accessible for students with learning disorders. It is recommended to use a plain, evenly spaced sans serif font such as Arial and Comic Sans. Others: Verdana, Tahoma, Century Gothic and Trebuchet. Spacing should be 1.5 and try to avoid justification in the text.**
- **At the end of each activity, take some time to ask the students what they have learnt to acknowledge every step in their learning process**
- **Make sure that the material the students manipulate is easy enough to grasp**
- **While using different media (paper, computer and visual aids) choose different background than white which can be too bright for students with learning disorders. The best choice would be cream or soft pastel but try to test different colours to learn more about student's preference.**
- **To stimulate short and long-term memory prepare for all the students in the classroom an outline describing what they are going to learn on this lesson and finish it with a resume of what has been taught. In this way they will strengthen the ability to remember information.**

EXAMPLE:

1. Start every lesson with a short "CHECK-IN"

- **Today, we will study the topic (name of the topic)**
- **I will tell you about: (name 3 keywords connected with the topic)**
- **Then I will present exercises: (name the exercises from the student book)**
- **Then we will do exercises (explain the way student will be working: ex. together with teacher / in pairs /individually)**
- **Once the exercises will be done [To continue]**

2. Then finish lesson with a short "CHECK-OUT"

- **During the lesson we learn about (topic of the lesson)**
- **The most important things were: (name 3 keywords connected with the topic)**

- **We were able to do… (tell about the work student done during the lesson)**
- **We will explore the topic next time when we will learn about (name the following topic)**

It is a small adjustment that will take 5 min from the lesson but can make a great difference in the way that the material will be remembered. Try to create this as a routine habit.