

4.	Memory & data storage: Principles of FLASH Memory
Target group	Pupils
Age	12–15
Duration	1-1.5 hours
Objective	To understand the basic data storage mechanism in FLASH memory, its advantages, and limitations compared to other types of memory.
Content	Vertikální trojité hradlo 100 nm > L > 10 nm It focuses on clarifying the fundamental data storage mechanism of FLASH memory. Students will first explore the function of the Floating Gate and how the electrical charge within it represents logical 0 and 1. They will then describe the processes of data writing and erasing using the Fowler-Nordheim Tunneling phenomenon. The final part of the task involves a critical comparison of the advantages and disadvantages of FLASH memory (e.g., its non-volatility versus limited lifespan) and an explanation of the differences between SLC and MLC types in terms of capacity, speed, and durability, thus providing students with a comprehensive understanding of this key technology used in modern electronics.
Instructions	1. Basic Principle (Floating Gate) FLASH memory stores data based on a trapped electrical charge within a transistor with a "Floating Gate." • Explain: How does the presence or absence of an electrical charge on this Floating Gate correspond to the storage of a logical one (1) and a logical zero (0)? (Hint: Focus on how the charge affects the transistor's conductivity.) 2. Write and Erase Operations Writing and erasing data in FLASH memory utilizes a phenomenon called Fowler-Nordheim Tunneling. • Briefly describe: How are data written (charge insertion) and data erased (charge removal) from the floating gate? What role do the oxide layer and the applied voltage play in this process? 3. Advantages and Disadvantages FLASH memory is used in USB drives, SSDs, memory cards, and phones. • List at least two (2) main advantages of FLASH memory that make it ideal for these devices (e.g., compared to a spinning hard disk drive or RAM memory). • State one (1) key disadvantage associated with its operating principle. (Hint: Consider the erase process and the aging of the memory.) 4. Types of FLASH Memory (SLC vs. MLC) We distinguish between two main types of FLASH memory: • Single-Level Cell (SLC): Stores 1 bit per cell. • Multi-Level Cell (MLC): Stores more than 1 bit per cell (typically 2 bits). • Explain: What does this mean for the memory's speed and lifespan (durability)? Which type is more expensive, and why?
Evidence	participant count