

# Curriculum Overview – Science 2024 - 2025

## Autumn-Winter 2024

### 1. Anatomy of movement.

1) Bones – chemical composition and structure. Strength and elasticity. Collagen protein and salt crystals. Tubular and flat bones – similarities and differences in structure. Bone modeling.

2) Muscles – contractile proteins as a moving element. Meat = Muscles. Muscles under a microscope. Striated and smooth muscles. The relationship between muscle volume and the strength developed. Endurance. Physiological experiments.

3) Tendons – the connection between bone and muscle. Structure and composition. Collagen. Chicken foot as an example of human hand work.

4) Cartilage – the hinges of the body. Types of cartilage. The surface of the cartilage in the joint and its lubrication. Friction. Diseases and aging of cartilage tissue. Models of joints.

5) Control and power supply of the motor system

a) blood

b) nerves

### 2. Mechanics and Gravity.

1) Gravity, elasticity, friction are the basics of interaction between bodies. Differences between mass and weight. Weight on land and under water. Gravitational field of different objects.

2) Muscular strength of humans and animals. Moving heavy objects in ancient times. Pyramids and Stonehenge. Lever. Effect of increasing dominoes.

3) Scales and mathematics. From lever to springs.

4) The invention of the wheel and the acceleration of progress. The use of the wheel in different mechanisms. The steam engine and the Stirling engine

5) Block as a lever. Pulley block. Well winch.

6) Screw and movement. From bolt to plane. A bit of aero- and hydrodynamics. Flying wheel and drones.

7) Winding mechanism and springs

## Winter-Spring 2025.

### 3. Electricity.

- 1) Electric charge and field. Charge accumulation and lines of force. Leyden jars. Registration of electric field by simple and complex methods.
- 2) Triboelectric effect. Static electricity generators – Van De Graaf and Wimhurst. Electric spark as visualized electric current. Lightning. Electrons and ions.
- 3) Electric current in conductors (metals and liquids). Dielectrics.
- 4) Electrochemistry. Electrolysis and electroplating. Silver plating of metals.
- 5) Electricity in living organisms. Muscles and their control.
- 6) Structure of an electric battery. Storage and accumulation of electricity.

### Magnetism.

- 1) Magnetic field. Permanent magnet. Magnetic materials. Compass as a magnetic field recorder.
- 2) The emergence of a magnetic field around a moving electric charge. Electromagnetic field and waves. Magnetic field of an electric coil.
- 3) Electromagnets, their application and production.
- 4) Conversion of magnetic field energy into mechanical energy. Electric motors.
- 5) Wireless electricity and the role of the magnetic field.
- 6) Tesla Coil

### **Spring-Summer 2025**

#### Strength of materials.

- 1) Strength of materials. Compression-tension. Iso- and anisotropy. Types of connections. Nails, screws, bolts and nuts. Model of a house built "without a single nail"
- 2) Glue, soldering and welding.
- 3) Suspended-tensioned structures. Tensegrity. Construction of suspended pyramidal structures.
- 4) Bridges. From Da Vinci Bridge to Canakkale Bridge. Isambard Kingdom Brunel and his legacy in the UK. Model of Da Vinci Bridge made of sticks.
- 5) Construction of a complex model of a bridge from pasta.

#### Chemical bonds and strength of objects.

- 1) Strength of materials and types of chemical bonds. Atoms, molecules, and their compounds. Model of the crystal lattice and what its strength depends on.
- 2) Growing a crystal in a closed, limited space (a bubble or a light bulb).

3) Flexibility and rigidity. Hydrogen bonds between molecules. Collagen and cellulose. Transformation of flexible into rigid by changing the chemical composition of the object – leather tanning.

4) Cellulose chemistry - fire-resistant paper and nitrocellulose.