The Material World (MW)

A. Properties

3. Properties of solutions
   - d. Concentration
     - v. Determines the concentration of an aqueous solution (g/L, percentage, ppm, mol/L)
   - f. Strength of electrolytes
     - i. Qualitatively speaking, associates the strength of an electrolyte with its degree of dissociation

B. Changes

3. Chemical changes
   - c. Oxidation
     - iii. Associates a chemical equation in which oxygen is one of the reactants with one of the possible cases of an oxidation reaction
   - h. Salts
     - i. Determines the molecular formula of the salt produced by the neutralization of a given acid and a given base
   - i. Types of bonds
     - i. Covalent
       - Defines a covalent bond as a bond resulting from a sharing of electrons
       - Makes a schematic representation of a covalent bond
       - Identifies molecules that feature a covalent bond (e.g. N_2, CO_2)
     - ii. Ionic
       - Defines an ionic bond as a bond resulting from the gain or loss of electrons
       - Makes a schematic representation of an ionic bond
       - Identifies molecules that feature an ionic bond (e.g. NaCl, NH4OH)
       - Associates an ionic bond with an electrolytic substance
   - l. Stoichiometry
     - i. Determines the quantities of reactants or products using stoichiometric calculations (gram or mole)
   - m. Endothermic and exothermic reactions
     - i. Distinguishes an endothermic reaction from an exothermic reaction according to perceptible signs (e.g. temperature variations, emission of light)
     - ii. Distinguishes an endothermic reaction from an exothermic reaction according to the position of the energy term in the chemical equation
4. Nuclear changes
   - a. Nuclear stability
     - i. Explains nuclear stability as the case where the nucleus of the atom is held together by an optimal number of neutrons
   - b. Radioactivity
     - i. Defines radioactivity as the emission of particles or energy by the nuclei of atoms following nuclear transformations
     - ii. Associates the use of radioactivity with technological applications (e.g. radiotherapy, dating)
   - c. Fission and fusion
     - i. Distinguishes nuclear fission from nuclear fusion
5. Transformation of energy
   - e. Relationship between thermal energy, specific heat capacity, mass and temperature variation
     - i. Describes qualitatively the relationship between the change in thermal energy (quantity of heat) of a substance, its mass, its specific heat capacity and the variations in temperature to which it is exposed
     - ii. Applies the mathematical relationship between thermal energy, mass, specific heat capacity and temperature variation ($\Delta E = Q = mc\Delta T$)

f. Effective force
   i. Defines effective force as the component of the applied force parallel to the direction of travel
   ii. Determines graphically the magnitude of the effective force in a given situation
g. Relationship between work, force and distance travelled
   i. Describes qualitatively the relationship between the work done, the force applied on a body and the distance travelled by the body
   ii. Applies the mathematical relationship between work, effective force and distance travelled ($W = F\Delta d$)
h. Relationship between mass and weight
   i. Describes qualitatively the relationship between mass and weight
   ii. Applies the mathematical relationship between mass and weight ($Fg = mg$)
i. Relationship between potential energy, mass, acceleration and distance travelled
   i. Describes qualitatively the relationship between the potential energy of a body, its mass, its gravitational acceleration and the distance it travels
   ii. Applies the mathematical relationship between potential energy, mass, gravitational acceleration and the distance travelled ($Ep = mgh$)
j. Relationship between kinetic energy, mass and speed
   i. Describes qualitatively the relationship between the kinetic energy of a body, its mass and its speed
   ii. Applies the mathematical relationship between kinetic energy, mass and speed ($Ek = ½mv$)
k. Relationship between work and energy
   i. Describes qualitatively the relationship between the work done on a body and the variation in energy within that body
   ii. Applies the mathematical relationship between work and energy ($W = \Delta E$)

C. Organization

1. Structure of matter
   i. Neutron
      i. Describes the position and electrical charge of the neutron in an atom
   j. Simplified atomic model
      i. Represents an atom of a given element using the simplified atomic model
   l. Nomenclature and notation rules
      i. Applies nomenclature and notation rules to name the molecule or write the molecular formula of binary compounds
   m. Polyatomic ions
      i. Recognizes the common polyatomic ions (e.g. NH_4^+ , OH^- , NO_3^- , CO_3^{-2} , SO_4^{-2} , PO_4^{-3}) by their name, their formula or their composition
   n. Concept of the mole
      i. Defines the mole as the unit of measure of the amount of a substance
      ii. Expresses an amount of a substance in moles
   o. Avogadro's number
      i. Expresses a quantity of particles using Avogadro's number
2. Periodic classification
   a. Atomic number
      i. Associates the atomic number of an element with the number of protons it has
   b. Isotopes
      i. Defines isotopes as atoms of the same element whose nuclei have different numbers of neutrons and therefore different atomic masses
      ii. Defines a radioactive isotope as an isotope whose atomic nucleus is unstable
   c. Relative atomic mass
      i. Explains qualitatively the concept of relative atomic mass
   d. Periodicity of properties

i. Describes the periodicity of certain properties of elements (e.g. chemical reactivity, atomic radius, electronegativity)

F. Electricity and electromagnetism

1. Electricity
   f. Kirchhoff's laws
      i. Describes the distribution of current in various components of an electrical circuit
      ii. Determines the value of the current flowing in various components of a series or parallel circuit
      iii. Describes the distribution of the voltage across various components of an electrical circuit
      iv. Determines the value of the voltage across various components of a series or parallel circuit
      v. Determines the value of the equivalent resistance of a series or parallel circuit using Ohm's law and Kirchhoff's laws
   g. Electrical field
      i. Describes qualitatively the effect of an electrical field on electrically charged particles
   h. Coulomb's law
      i. Applies the mathematical relationship between the electrical force, the magnitude of the electrical charges and the distance separating these charges ($F = kq_1q_2 /r^2$)
2. Electromagnetism
   c. Magnetic field of a solenoid
      i. Describes the magnetic field produced by a solenoid (right-hand rule or left-hand rule)
      ii. Names ways of changing the intensity of the magnetic field produced by a solenoid (nature of the core, intensity of the current, number of turns)
      iii. Explains the use of solenoids in technological applications (e.g. earphones, electric motor, magnetic crane)

The Living World (LW)

A. Diversity of life forms

1. Ecology
    h. Ecological footprint
        i. Explains the concept of ecological footprint
    i. Ecotoxicology
        i. Contaminant
            - Defines a contaminant as an agent that causes changes in the physical, chemical or biological properties of an environment or an organism
        ii. Bioaccumulation
            - Defines bioaccumulation as the process by which a contaminant from the environment or food supply accumulates in an organism
            - Explains bioaccumulation in food chains (biomagnification)
        iii. Bioconcentration
            - Defines bioconcentration as a special case of bioaccumulation by which an organism accumulates a contaminant through direct contact with its environment (from sources other than food)
        iv. Toxicity threshold
            - Defines the toxicity threshold of a substance as the minimum concentration of a substance that produces a significant harmful effect in an organism (mg/kg of the organism's mass)
            - Describes factors that influence the toxicity of a contaminant (e.g. concentration, characteristics of the environment into which it is released, nature of the organisms with which it is in contact, duration of exposure)

3. Genetics
    a. Heredity
        i. Defines heredity
    b. Gene
        i. Defines a gene as being, in most cases, a DNA segment that carries the code for synthesizing one or more proteins
        ii. Describes the composition (nitrogen bases, sugar, phosphate) and the overall structure (bonding of bases on the double helix) of a DNA molecule
    c. Character trait
        i. Defines what an hereditary trait is
        ii. Names hereditary traits in an individual or population
    d. Allele
        i. Defines an allele as a possible form of a gene
    e. Homozygotes and heterozygotes
        i. Defines a homozygote as an individual with two identical alleles for a particular character trait
        ii. Defines a heterozygote as an individual with two different alleles for a particular character trait
    f. Dominant and recessive
        i. Describes the phenomena of dominant and recessive character traits
    g. Genotype and phenotype
        i. Defines genotype
        ii. Defines phenotype
        iii. Describes an individual's genotype and phenotype for a character trait (e.g. a bean with a Yellow phenotype may have a Yellow-Yellow genotype or a Yellow-Green genotype)
    h. Protein synthesis
        i. Describes the role of DNA in protein synthesis
        ii. Explains the phenomena of transcription and translation of a strand of DNA
    i. Crossbreeding
        i. Explains the relationship between the crossbreeding carried out by humans on animals and plants and the desired traits obtained

The Earth and Space (ES)

A. Characteristics of the Earth

2. Lithosphere
   - m. Soil depletion
     - i. Explains how human activities contribute to soil depletion
   - n. Buffering capacity of the soil
     - i. Defines the buffering capacity of a soil as its ability to limit pH variations
     - ii. Explains the advantages of a good soil buffering capacity
   - o. Contamination
     - i. Names soil contaminants
   - p. Biogeochemical cycles
     - iii. Phosphorous cycle
       - Describes transformations related to the circulation of phosphorous (e.g. erosion of rocks, breakdown of fertilizers, metabolism of algae)
3. Hydrosphere
   - f. Contamination
     - i. Names water contaminants
   - g. Eutrophication
     - i. Explains the natural process of eutrophication of a body of natural water
     - ii. Explains how human activities accelerate the eutrophication of a body of natural water
4. Atmosphere
   - d. Atmospheric circulation
     - ii. Describes the effect of prevailing winds on the dispersal of air pollutants in a given region
   - f. Contamination
     - i. Names air contaminants

The Technological World (TW)

A. Graphical language

f. Orthogonal projections
   v. Interprets assembly drawings of technical objects consisting of a small number of parts

i. Axonometric projection: exploded view (reading)
   i. Names the characteristics of an exploded view
   ii. Explains the purpose of exploded views (projection accompanying the assembly instructions or specifications for an object)

l. Dimensional tolerances
   i. Defines tolerance as the required manufacturing precision (dimensions indicated on the drawing, along with allowances)

B. Mechanical engineering

3. Engineering

d. Degree of freedom of a part
   i. Explains the purpose of limiting motion (degree of freedom) in a technical object (e.g. some hinges limit how far a cupboard door can open, preventing it from hitting the wall)

g. Adhesion and friction of parts
   i. Describes the advantages and disadvantages of the adhesion and friction of parts in a technical object

m. Construction and characteristics of motion transformation systems
   ii. Explains the choice of a motion transformation system (screw gear, cams, connecting rods, cranks, slider-crank mechanism, rack-and-pinion drive, eccentric) in a technical object

C. Electrical engineering

b. Conduction, insulation and protection
   v. Uses the colour code to determine the electrical resistance of a resistor
   vi. Describes the operation of a printed circuit

c. Control
   iii. Distinguishes between unipolar and bipolar switches
   iv. Distinguishes between unidirectional and bidirectional switches

e. Other functions
   i. Describes the function of certain electronic components (condenser, diode)

D. Materials

2. Mechanical properties of materials

f. Heat treatments
   i. Defines heat treatments as ways of changing the properties of materials (e.g. quenching increases hardness but fragility as well)

E. Manufacturing

c. Shaping
   i. Machines and tools
      - Associates shaping processes with the types of materials used (e.g. injection blow moulding is used to shape plastics)
      - Determines the appropriate shaping techniques based on direct observation of technical objects (e.g. some table legs are turned on a lathe)

d. Manufacturing
   i. Characteristics of laying out, drilling, tapping and threading
      - Associates laying out (marking) with saving materials, shaping techniques and the types of materials to be shaped
      - Describes the characteristics of the tools needed to shape a material to be machined (e.g. the tip of a metal drill is conical, while that of a wood drill is double fluted)

e. Measurement
   i. Direct measurement
      - Explains the purpose of direct measurement (using a ruler) to control the machining of a part
      - Explains the choice of the direct measurement instrument used (a vernier caliper is more precise than a ruler)

F. Biotechnology

a. Processes
   vi. Cloning
      - Defines cloning as a reproductive process that results in an identical copy of an organism, a tissue or a cell, whether genetically modified or not
      - Describes the main advantages and disadvantages of cloning
   vii. Wastewater treatment
      - Describes treatments used to decontaminate wastewater
   viii. Biodegradation of pollutants
      - Describes ways to promote biodegradation of pollutants (e.g. phytoremediation)