



# UNIVERSAL *Curriculum*

Content & eLearning Technologies for K-12 Education

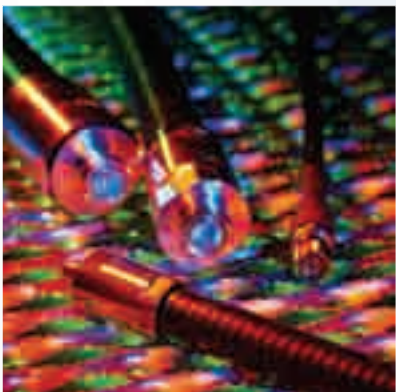


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## Introduction

The development of Information and Communication Technology over the last two decades has influenced almost every aspect of our everyday life. It has been widely introduced in the majority of industries. It is difficult to imagine a discipline where computers do not play an important role in supporting a variety of processes, enhancing productivity or helping to organise and manage information. ICT has been widely introduced in higher education, but not fully deployed within primary and



secondary education. It seems, however, that the process of introducing modern information technology in this segment has already begun and is accelerated by an increasing number of initiatives taken by many governments that support the development of competitive and well educated Information Societies.

In order to comply with the standards of developed countries, every national educational system has to address the issue of equal access to quality education and make efforts to enhance effectiveness of teaching and learning processes. It seems that a high appreciation of modern technology among children and teenagers as well as among a constantly increasing number of teachers opens new possibilities for ICT.



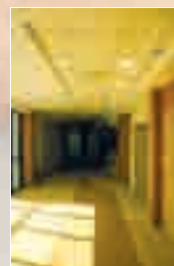
## Company profile

Young Digital Planet has addressed the issues related to educational technology since it was formed in 1990. Extensive experience built over years of activity has allowed YDP to become one of the world's leaders in delivering interactive learning solutions for individual and institutional clients. Starting with language learning solutions, YDP has established its international position as a leading developer of high-quality educational software. Nowadays, the company's products, both off-line and on-line, are available in over 20 countries worldwide.

Since 2001, YDP has co-operated with a number of educational publishers from Europe and Asia developing educational software in a variety of subjects as a natural extension of their traditional printed textbooks.

YDP employs almost 400 dynamic and creative professionals from different disciplines who are focused on the development of educational electronic content and e-Learning technology.

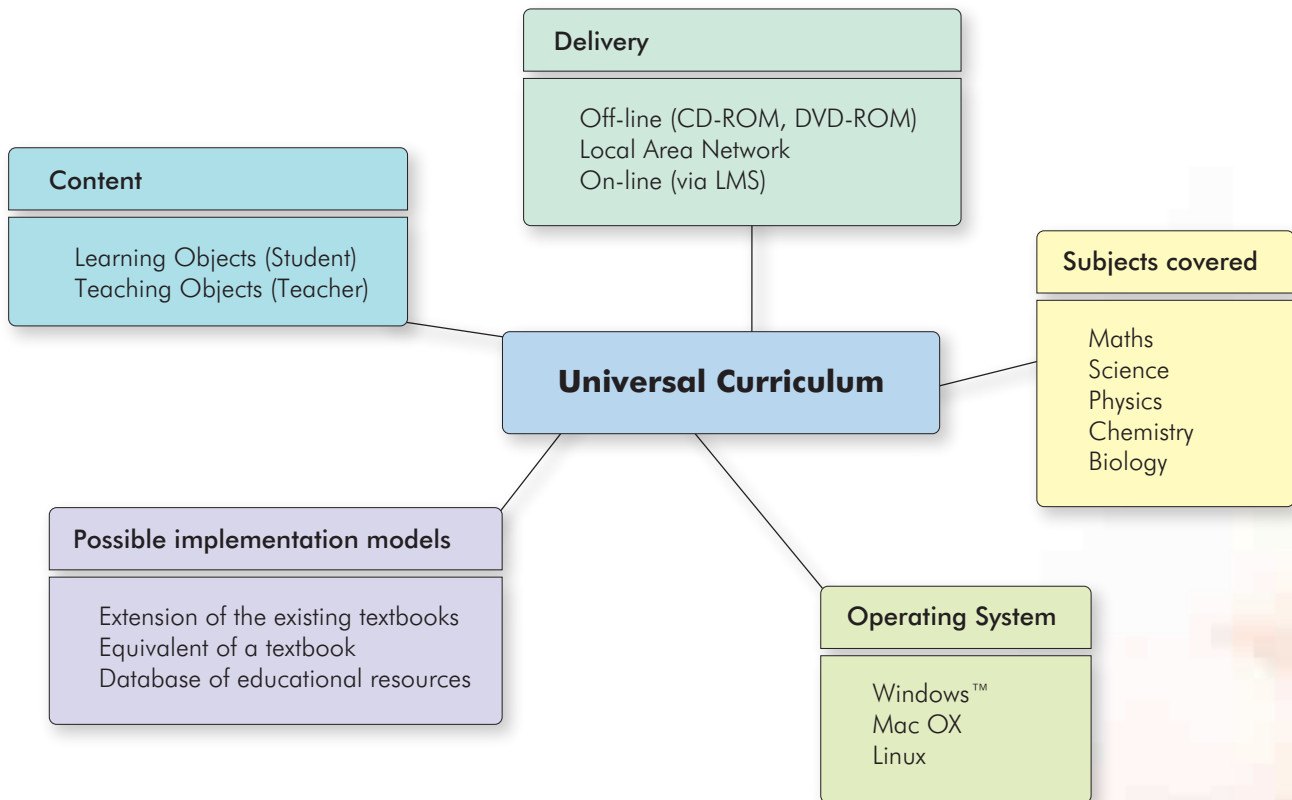
In 2004, it became a part of Sanoma WSOY Education Group, which comprises WSOY Education from Finland, Malmberg from the Netherlands, Van In from Belgium, Nemzeti from Hungary and Young Digital Planet. The ambition of Sanoma WSOY Education Group is to become a leading, modern European educational publisher that combines traditional print media with high-quality electronic publishing and related educational technology.



# Universal Curriculum

Universal Curriculum is an extensive and flexible product that can serve a variety of needs of modern education in the K-12 segment. Being a combination of amazing-quality digital content and advanced e-Learning technology, Universal Curriculum is a perfect choice for any educational system that intends to support the development of a modern Information Society.

Universal Curriculum is a 'one-stop shop' for anyone who is looking for superior quality and a solution that brings educational processes on a very new level of attractiveness and efficiency.



# Scope of Universal Curriculum

Universal Curriculum is a pool of electronic Content covering the main curriculum subjects taught at the level of K–12 education. The subjects within the UC project include: Science, Mathematics, Physics, Chemistry and Biology. Each subject relates to the relevant level of the general education system, starting from Upper Primary School up to Upper Secondary School. The Universal Curriculum content is prepared as a generic pool of electronic resources, flexible enough to be quickly adapted to any national curriculum, particular textbook or specific teaching concept.

## Universal Curriculum



### Upper Primary – Age 10 to 13

Mathematics  
Science



### Lower Secondary – Age 13 to 16

Mathematics  
Physics  
Chemistry  
Biology



### Upper Secondary – Age 16 to 19

Mathematics  
Physics  
Chemistry  
Biology

# Student content

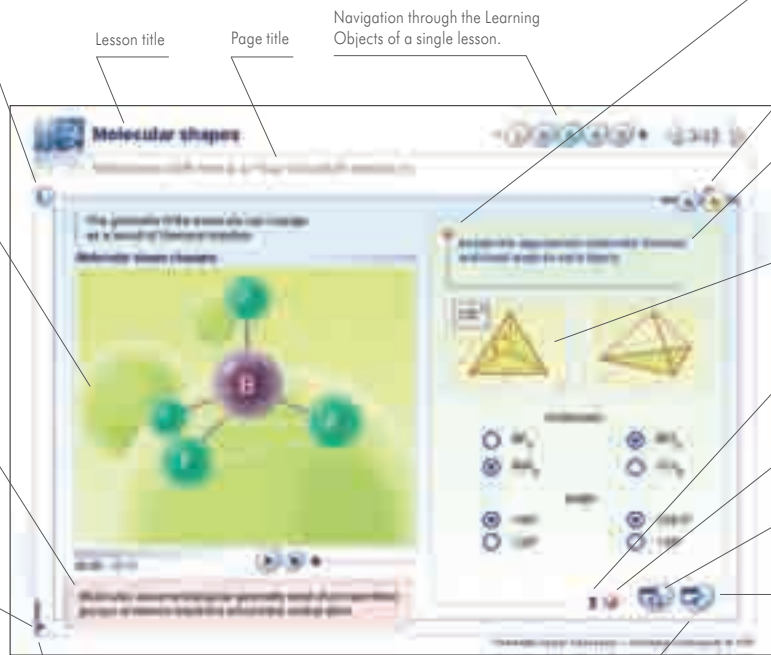
The content offered for each subject at a particular level of a school system (e.g. Biology for Lower Secondary School) consists of over one hundred student lessons and the same number of corresponding teacher lessons. Each of these lessons consists of approximately ten interactive Learning Objects designed to meet a particular educational goal. The students' Learning Objects are designed to help learners acquire the appropriate skills and knowledge in an intuitive, efficient and motivating way. Every single Learning Object is created as a dynamic object that continuously tracks a particular student's performance and adapts the content to his or her skills and progress. Such an approach makes the learning process really and truly individualised.

Tips to help learners understand the purpose and goals of a particular Learning Object.

Animations, videos or simulations presenting the educational content in an attractive and inspiring way.

Text feedback on wrong answers appears dynamically on the screen. It is context-dependent and differs according to the type of error made as opposed to a simple right/wrong feedback.

Toolbar with additional tools prepared to enhance the learning process.



An indicator that informs a learner if a particular activity is solved or if there is still an error to be corrected.

Layers that accommodate electronic resources and interactive activities in one logical Learning Object and make the layout and navigation clear and intuitive.

Clear instructions for the activities.

Animated feedback, which is provided on wrong answers, helps learners to understand the topic better and correct their answers.

Indicator that informs whether the learner has used Help options from the activity report window (for example: 'show the right answers').

Indicator showing the number of mistakes that the learner has made while solving the activity.

Icon to clear the activity and allow learner to solve it again.

Icon to open Activity Report window and check the answers or get extensive help within the activity.



'Glossary' is a collection of terms used throughout the material with their definitions.



Marks correct answers in the activity.

Marks all wrong answers in the activity.

Shows total answers that should be given in the activity.

Removes all wrong answers from the activity.

Clears the activity.

Interactive 'Periodic Table' collects all relevant data concerning chemical elements that are presented in an attractive and easily accessible format.



'Biography' presents important scientists in particular disciplines.



'Calculator' helps to solve some activities without the necessity of going outside the Learning Object.

# Teacher content

Teaching and Learning are two complementary processes but they require different resources. Universal Curriculum content supports both of them, providing a huge pool of teaching and learning resources. Every student lesson is accompanied by equivalent teacher's resources. The teacher content can be used in classroom presentations, with the help of a projector or a whiteboard. Every teacher lesson is supported by a number of tools that allow the teacher to modify the content and restructure it according to his or her actual needs.

Title of the lesson can be easily modified by a teacher.

Title of the page, which the teacher can easily modify in every Teaching Object.

Large number of Teaching Objects prepared for every lesson.

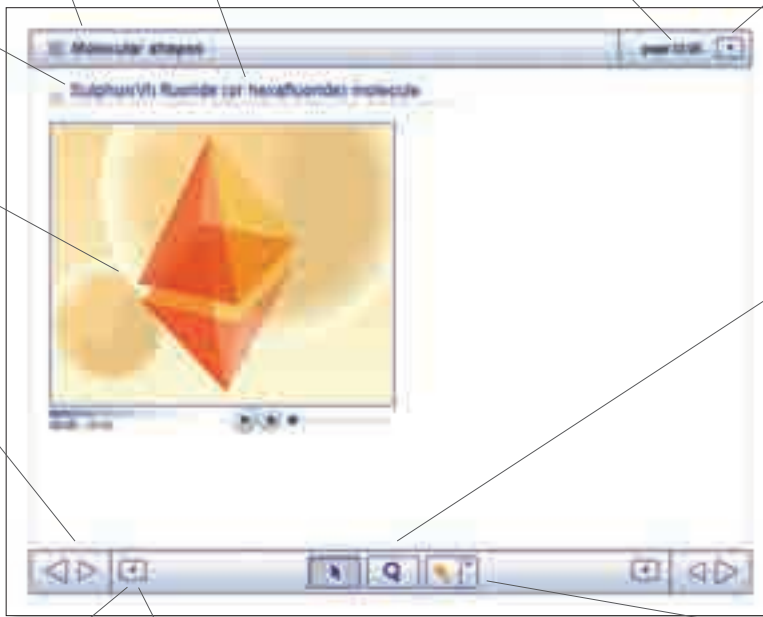
Easy navigation that allows the teacher to move to any selected Teaching Object.

Bigger fonts to make the content clear and visible to the class audience.

Rich and attractive animations, videos and simulations that easily attract learners' attention during the classroom presentation.

Navigation icons, which allow you to move to the next or previous screen, are situated on both sides of the screen to make the class presentation convenient while working with the whiteboard.

Icon that opens an additional Toolbar with a number of options available for presentation. Initially, the Toolbar is hidden in order not to distract students' attention from the content screen. The teacher can easily show or hide this toolbar according to his or her preferences.



Zoom option allows the teacher to magnify any part of the screen, including animation, video or part of the activity and demonstrate it to the class in an enlarged size.



A drawing tool, which allows the teacher to make any annotation on the screen. All annotations are saved between sessions together with the content, allowing teachers to prepare their own versions of the material. The drawing tool consists of pencil, marker, line, circle, rectangle.



Teaching Objects also contain interactive activities that can be solved with the students during a presentation. Audio feedback may be played on every right or wrong answer whilst solving these activities. The teacher can switch it on and off with a single icon.

Every Teaching Object can be enriched by any number of additional slides created by a teacher as extra notes to a particular Teaching Object. The annotation tools are also available to create additional slides.

Advanced Zoom option allows magnification of any selected region of a screen with any magnification. Zoom option allows easy navigation through magnified screen.

Undo and Redo options facilitate the editing of annotations.

A variety of hide and erase options help to modify annotations placed in a Teaching Object.

The colour or line thickness of any annotation made in a Teaching Object can be easily adjusted.



Built-in text editor allows adding of extra texts to the original Teaching Object.



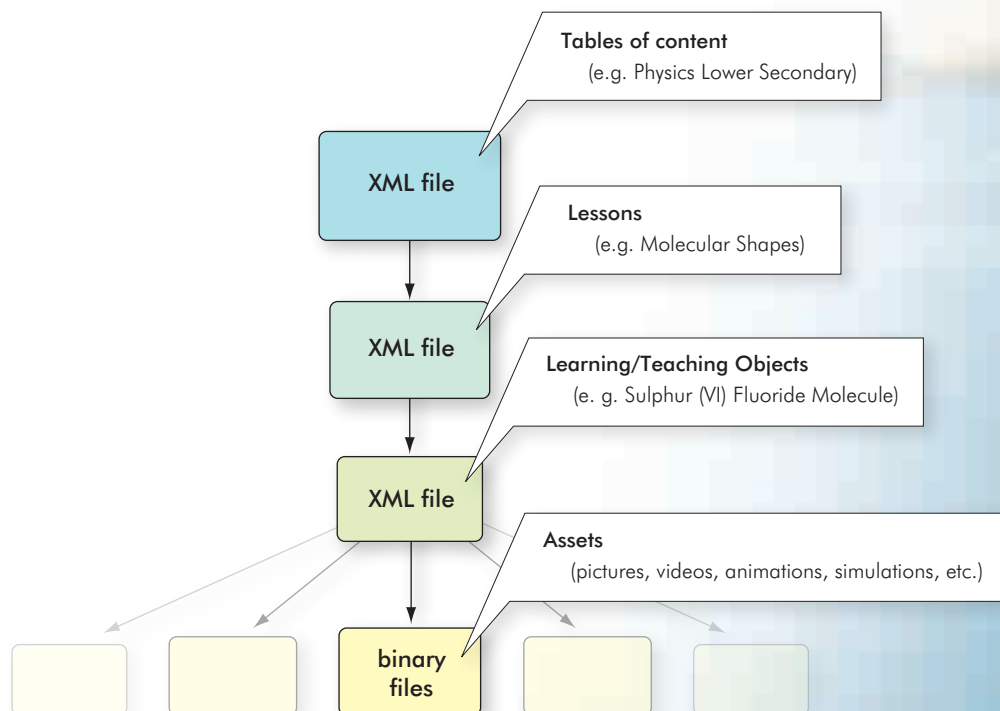
Lesson Editor allows the teacher to make selection of the preferred Teaching Objects and change their order to facilitate his or her presentation.

# Structure of Universal Curriculum content

## XML-based content

All Universal Curriculum content is created in the form of XML files. This approach makes it open and ready for further maintenance, changes and adaptations. XML format is a perfect solution for extensive searches through tens of thousands of content objects of Universal Curriculum.

Using XML has an additional and very important benefit. Every e-content object that constitutes Universal Curriculum is processed by a single piece of software application. The so-called XML Player interprets the XML files and dynamically produces rich and fully interactive objects displayed on the user's screen. In case of the need to extend or adapt the Universal Curriculum content, to be compatible with new versions of operating systems or the next generation of computer devices such as PDAs or 3G phones, there is only one piece of software (XML Player) that has to be modified. There is no need to change software codes in thousands of individual e-content objects. Universal Curriculum really is ready for the future!



## UC logical structures

The Universal Curriculum content is originally structured in Tables of Contents, Lessons and Learning and Teaching Objects. However, it can also be used as a free combination of any of its components.

### Courses

Every subject for each educational stage is carefully structured in the form of Tables of Contents that aggregate Lessons organised in chapters. Students and teachers can use this structure to follow the suggested order and pedagogical approach.

### Lessons

The Lessons that are structured in Tables of Contents can be also treated as a pool of randomly accessed teaching or learning resources. Each lesson consists of a number of carefully designed and structured Teaching or Learning Objects that serve particular learning goals. Every Lesson is precisely meta-tagged with relevant information to allow efficient and extensive search.

### Learning and Teaching Objects

Each of the available Learning or Teaching Objects can also be a stand-alone teaching or learning resource. Every such object is independent and can be treated as a single element of a huge database of educational resources.

# Models of implementation

Universal Curriculum is not only a pool of educational electronic content, but also a set of relevant technologies that make the content applicable in a variety of technological environments. All material can be deployed as: stand-alone CD or DVD-ROM-based application, a network installation in a school local network, or as a fully on-line solution accessed via the Internet within the Learning Management System. All of the above-mentioned solutions are available within the Universal Curriculum offer.

## Stand-alone application

Any part of Universal Curriculum content can be used to create a set of stand-alone, off-line applications that can be used on any operating system with easy and intuitive installation. The off-line application allows a student or teacher to log-in and save their personal results or annotations. It allows you to: access the content, search it through, build your own set of lessons, make notes associated with an individual Learning or Teaching Object and view the results of the learning progress.

## Network application

When deployed within a school local network, the Universal Curriculum gets another dimension. All content and all students' results can be kept centrally on a local server. Due to the excellent administrative part of the network version, a teacher is able to manage the students, organise them in groups and control their access to the specific parts of the content. He or she also has access to a variety of reports generated on the basis of learners' results. A teacher is also able to create his or her own lessons composed of Universal Curriculum Learning Objects and assign them to selected groups of students.

## On-line applications

The most efficient and natural model of usage of Universal Curriculum content can be achieved in the on-line environment. Any piece of Universal Curriculum content can be prepared as a standard SCORM package and deployed in any SCORM-compliant LMS. The best results, however, can be achieved by using Young Digital Planet's proprietary Leo LMS or yTeach applications. Both applications allow accessing the content at any time and any place. yTeach is an on-line approach to provide teachers with a pool of resources together with the possibility to create their own presentations and assignments whereas Leo LMS offers a wide pool of group working and communication tools for students and teachers. Due to its flexible structure and advanced functional design, Leo LMS is able to replicate a complex structure of a national school system with thousands of virtual schools and virtual classes.



## Why select on-line or network solution?

Universal Curriculum content consists of learners' and teachers' elements that were created as complementary elements and that are to support each other. Once the material is used in a network or on-line environment, users can start to benefit from this approach – the results of the learners' work can be referred to the teachers' content that is to be presented during the lesson. Such an approach makes the learning and teaching processes fully complementary. The teacher can analyse students' results, time they spent on the material, number of mistakes they made or number of hints they requested while solving the activities, and thus select presentation materials that are really relevant to students' actual needs. Teachers can really focus on topics that seem to be difficult to their students and illustrate the lessons with the appropriate Teaching Objects from the UC content.

# Mathematics - Upper Primary level



## I. Using and applying Maths (1)

1. Solving word problems
2. Small steps
3. Explain and justify

## II. Numbers and the Number System (1)

4. Ordering decimals
5. Fractions, ordering fractions
6. Changing fractions into decimals and percentages
7. Negative numbers
8. Multiples, factors and powers
9. Triangular and square numbers
10. Rounding numbers
11. Ratio and proportion
12. Written methods
13. Calculator methods

## III. Algebra (1)

14. Writing algebraic expressions
15. Simple operations on algebraic expressions
16. Like terms
17. Simple linear equations
18. Substituting into the formulas
19. Sequences
20. What a function is?
21. Graph of a linear function

## IV. Space, shape and measures (1)

22. Lines and angles
23. Mutual position of lines and interior angles in a triangle
24. Properties of shapes
25. Transformations
26. Angles in 2-D shapes
27. Representations
28. Angles in 3-D shapes
29. Coordinates
30. Measurements
31. Area of rectangles
32. Surface area

## V. Handling Data (1)

33. Data planning and collecting
34. Data reporting
35. Averages
36. Comparing data
37. ITC and data handling
38. Probability scale
39. Probability of events in simple experiments

## VI. Using and applying Maths (2)

40. Solving word problems
41. Small steps
42. Using ITC in calculations

## VII. Numbers and the Number System (2)

43. Multiplication and division by 0.1 and 0.01
44. Ordering decimals on a number line
45. Rounding numbers
46. Numbers
47. Multiples, factors and powers
48. Squares and square roots, cubes and cube roots

49. Recurring decimals
50. Adding and subtracting fractions
51. Multiplication and division of integers by fractions
52. Percentages
53. Ratio and proportion
54. Mental methods
55. Written methods
56. Calculator methods

## VIII. Algebra (2)

57. Letter symbols in formulas
58. Transformation of algebraic expressions
59. Simple linear equations
60. Solving equations using graphs
61. Formula based calculations
62. Notation of simple sequences
63. Sequences based on rules
64. The nth term of a sequence
65. Reading graphs of linear functions
66. Linear functions and their graphs in real life

## IX. Space, shape and measures (2)

67. Angles in triangles and quadrilaterals
68. Angles in simple polygons
69. Symmetry and congruency
70. Representations
71. Transformations
72. Coordinates of midpoints of line segments
73. Properties of 2-D shapes
74. Ruler-and-compass constructions
75. Drawing simple shapes using ITC
76. Measurements in real life
77. Areas of polygons
78. Surface area and volume of cuboids

## X. Handling Data (2)

79. Data planning and collecting
80. Data processing
81. Using ITC for data presentation
82. Comparison of two simple data distributions
83. The vocabulary of probability
84. Probability experiments

## XI. Using and applying Maths (3)

85. Solving word problems
86. Small steps
87. Explain and justify

## XII. Numbers and the Number System (3)

88. Place value
89. Rounding to decimal places
90. Numbers
91. Multiples, factors and powers
92. Squares and square roots, cubes and cube roots
93. Working with recurring decimals

94. Operations on fractions
95. Percentages
96. Ratio and proportion
97. Mental methods
98. Written methods
99. Calculator methods

## XIII. Algebra (3)

100. Letter symbols in equations, formulas and functions
101. Simple examples of index laws
102. Transformation of algebraic equations
103. Composing and solving linear equations
104. Simplification of equations
105. Working with functions
106. General term of a sequence
107. The expression for the nth term
108. Linear functions
109. Graphs and functions
110. Graphs

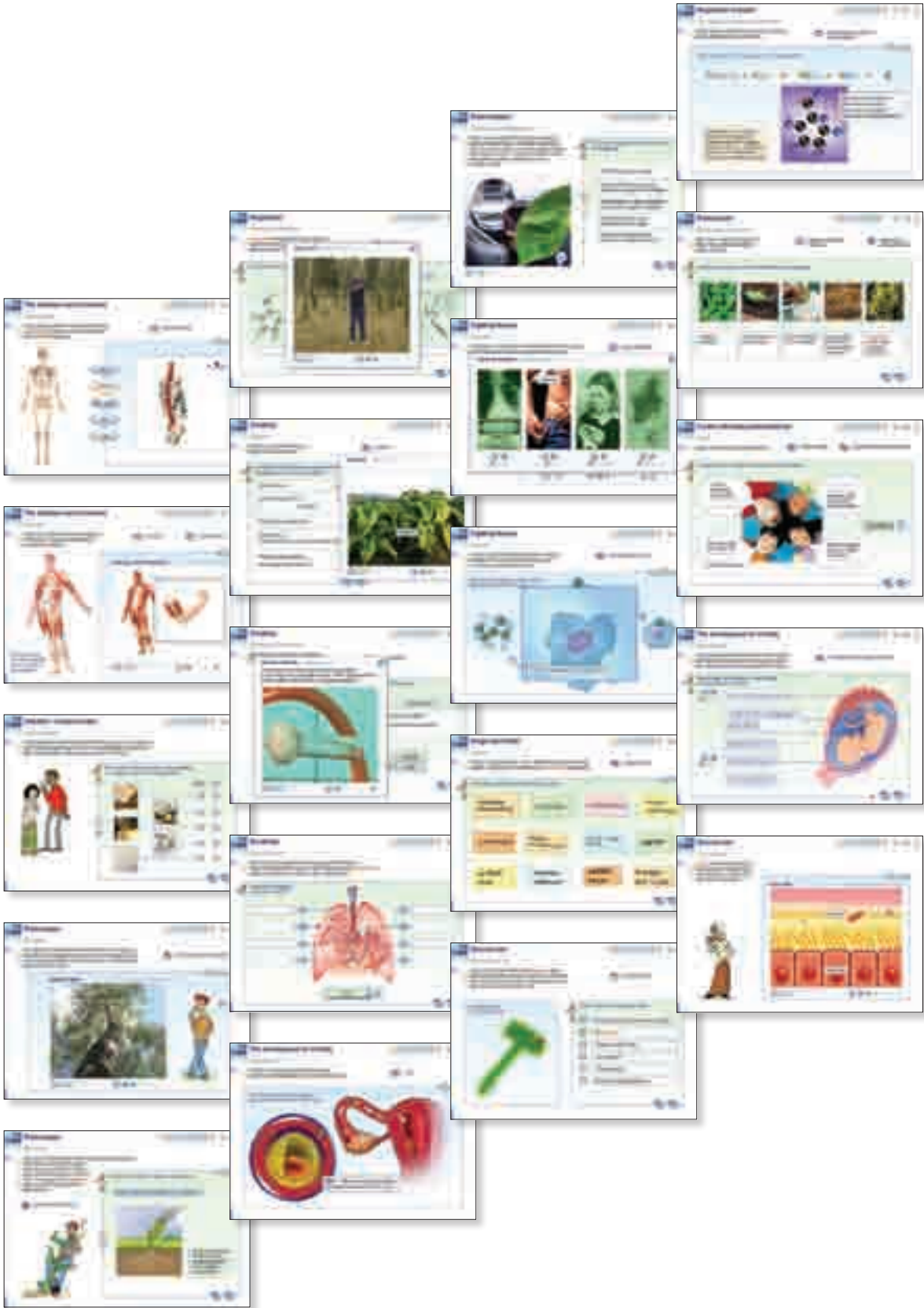
## XIV. Space, shape and measures (3)

111. Interior and exterior angles in polygons
112. Problems involving properties of angles and parallel lines
113. Symmetry and congruency
114. Circle properties
115. Representations
116. Transformations
117. Enlargements
118. Scale drawing
119. Ruler-and-compass constructions
120. The transformed point's image
121. Changing units
122. Areas of rectangles
123. Circumference of a circle
124. The area of a circle
125. Surface area and volume of regular polyhedrons

## XV. Handling Data (3)

126. Interpretation of collected data
127. Usage of secondary data
128. Using ITC for comparing data
129. Comparing two simple distributions using charts
130. Presentation and interpretation of a statistical enquiry
131. An application of the vocabulary of probability
132. Experimental and theoretical probabilities

# Science - Upper Primary level



## I. Life processes and Cell Functions

1. Animal and plant cells
2. Plant organs
3. Special cells
4. Human organ systems
5. Life processes

## II. Humans as Organisms

6. Nutrition: a balanced diet
7. Digestion
8. Absorption and waste
9. The skeleton and movement
10. Adolescence
11. Human reproduction
12. Development of the foetus
13. Breathing
14. Smoking
15. Respiration
16. Drugs and health
17. Fighting disease

## III. Green Plants as Organisms

18. Plant nutrition
19. Factors affecting photosynthesis
20. Plant growth
21. Respiration in plants

## IV. Variation, Classification and Inheritance

22. Variation
23. Causes of variation
24. Classification
25. Inheritance

## V. Living things in their environment

26. Sustainable development
27. Habitats
28. Adaptation
29. Survival
30. Food chains
31. Food webs

## VI. Grouping and classifying materials

32. Solids, liquids and gases
33. Particle theory
34. Physical changes
35. Elements
36. Properties of metals
37. Properties of non-metals
38. Compounds
39. Names of compounds
40. Mixtures
41. Separating mixtures

## VII. Changing Materials

42. Physical changes in materials
43. Solutions
44. Geological changes: weathering
45. Rock formation
46. Chemical reactions
47. The effects of combustion

## VIII. Patterns of behaviour

48. The reactivity of metals
49. Displacement reactions
50. Acids and alkalis
51. Acid reactions
52. Neutralisation

## IX. Electricity

53. Electric circuits
54. Series and parallel circuits
55. Electric current
56. Magnets
57. Electromagnets

## X. Forces and motion

58. Speed
59. Weight
60. Balanced and unbalanced forces
61. Friction
62. Force and rotation
63. Moments
64. Pressure

## XI. Light and Sound

65. Light
66. Reflection
67. Refraction
68. Colour
69. Sound
70. Hearing

## XII. The Earth and beyond

71. The movement of the Earth
72. The solar system
73. The Sun
74. Satellites

## XIII. Energy Resources and Energy Transfer

75. Energy
76. Energy resources
77. Generating electricity
78. Heat and temperature
79. Transfer of energy
80. Energy conservation



## I. Numbers (1)

1. Integers
2. Divisibility
3. Prime factor decomposition
4. Fractions
5. Operations on fractions
6. Decimals
7. Decimals and fractions
8. General division
9. Powers and roots
10. Standard index form
11. Use of a calculator

## II. Geometry and transformations

12. Triangles
13. Congruence of triangles
14. Quadrilaterals and their properties
15. Polygons and regular polygons
16. Coordinates
17. Symmetry
18. Translations, reflections, rotations
19. Enlargements
20. Similarity
21. Similarity – solving problems

## III. Algebraic expressions

22. Algebraic expressions
23. Multiplying out the brackets
24. Multiplication formulas
25. Factorisation (by grouping)
26. Factorisation (other methods)
27. More factorisation

## IV. Algebraic fractions (1)

28. Solving equations involving algebraic fractions
29. Changing the subject of the formula

## V. Reasoning

30. Mathematical statements
31. Deductive reasoning
32. Understanding the theorem
33. Problem solving
34. Problem assumptions

## VI. Sets

35. Sets

## VII. Handling Data

36. Problem specification
37. Sampling
38. Representing data
39. Measures of central tendency – the arithmetic mean
40. Measures of central tendency – the mode, the median
41. Measures of variability (1)
42. Measures of variability (2)
43. Cumulative frequency curve
44. Skewness
45. Case study (1)
46. Case study (2)

## VIII. Geometry – Pythagorean theorem

47. Pythagorean theorem
48. Application of the Pythagorean theorem in 2-D

49. Application of the Pythagorean theorem in 3-D
50. Ruler-and-compass constructions, locus (1)
51. Ruler-and-compass constructions, locus (2)

## IX. The circle

52. The circle
53. Circle theorems
54. Inscribed and central angles
55. Equation of a circle
56. Mutual position of two circles
57. Mutual position of a line and a circle
58. Circles inscribed and circumscribed
59. Solving problems involving circles

## X. Percentages

60. Percentages
61. Solving problems involving percentages
62. Repeated percentage change

## XI. Sequences

63. Looking for the pattern
64. Finding the  $n$ th term of a sequence

## XII. Ratio and proportion

65. Ratios
66. Proportions
67. Direct proportion
68. Inverse proportion
69. Rates of change

## XIII. Trigonometry (1)

70. Trigonometric ratios in a right-angled triangle
71. Solving problems involving trigonometric ratios
72. Trigonometry of a general angle
73. Properties of trigonometric functions of a general angle (1)
74. Properties of trigonometric functions of a general angle (2)
75. Graphs of trigonometric functions
76. Use of a calculator

## XIV. Probability

77. Random processes
78. Counting problems
79. Classical concept of probability (1)
80. Classical concept of probability (2)
81. The set of possible outcomes
82. Mutually exclusive events
83. Independent events (1)
84. Independent events (2)
85. Solving simple problems in probability

## XV. Graphs of different functions

86. A function and its graph
87. Equation of a straight line
88. Linear function
89. Quadratic function (1)
90. Quadratic function (2)
91. Other functions
92. Graphs and real-life situations

## XVI. Measures on the plane and in space

93. Measuring (1)
94. Measuring (2)
95. Areas of plane shapes (1)

96. Areas of plane shapes (2)
97. Volume and surface area of prisms
98. Volume and surface area of pyramids
99. Volume and surface area of cylinders and spheres
100. Volume and surface area of cones
101. Volumes of similar solids

## XVII. Solving equations

102. Linear equations, solving linear equations
103. Solving simultaneous linear equations (1)
104. Solving simultaneous linear equations (2)
105. Solving problems involving simultaneous equations
106. Solving quadratic equations
107. The quadratic formula
108. Solving problems involving quadratic equations (1)
109. Solving problems involving quadratic equations (2)
110. Solving equations by trial and error (1)
111. Solving equations by trial and error (2)

## XVIII. Algebraic fractions (2)

112. Inequalities (1)
113. Inequalities (2)

## XIX. Numbers (2)

114. Powers, roots and indices
115. Irrational numbers

## XX. Vectors

116. Vectors
117. Operations on vectors
118. Scalar multiple
119. Applications of vectors

## XXI. Correlation and regression

120. Sampling techniques
121. Regression line
122. Correlation
123. Analysing and comparing sets of data
124. Using probability to analyse random events

## XXII. Trigonometry (2)

125. Trigonometric equations (1)
126. Trigonometric equations (2)
127. The sine formula for the area of a triangle
128. Solving problems involving trigonometric equations
129. Pythagorean theorem and trigonometry in 3-D

## XXIII. Transformations of graphs

130. Transforming graphs of various functions
131. Transforming graphs of trigonometric functions (1)
132. Transforming graphs of trigonometric functions (2)
133. Using graphs (1)
134. Using graphs (2)
135. Graphs of simple loci
136. Area under a curve
137. Tangents to graphs

# Physics - Lower Secondary level



## I. Forces

1. Forces
2. Addition of forces
3. Force measurement
4. The moment of a force
5. Equilibrium
6. Levers and pulleys

## II. Motion

7. Displacement, distance and velocity
8. Acceleration
9. Graphs of motion
10. Accelerating motion
11. Curvilinear motion

## III. Forces and motion

12. Force and acceleration
13. Momentum
14. Inertia
15. Friction
16. Air resistance
17. The force of reaction

## IV. Energy

18. Work
19. Potential energy
20. Kinetic energy
21. Energy conversions
22. Power
23. Efficiency

## V. Gravitation

24. Gravitation
25. Free fall
26. Space flights
27. Satellites

## VI. Matter

28. Gases, liquids and solids
29. Properties of matter
30. Density
31. Temperature
32. Thermal expansion
33. Expansion of gases

## VII. Pressure

34. Pressure
35. Pressure of a liquid
36. Air pressure
37. Gas laws
38. Buoyant force
39. Floating bodies

## VIII. Heat

40. Specific heat
41. Thermal transfer
42. Melting and freezing
43. Evaporation and condensation
44. Sources of heat
45. Efficiency and economy

## IX. Electrostatics

46. Charging objects
47. Conductors and insulators
48. Capacitors
49. Application of static electricity and the threats it poses

## X. Direct current

50. Cells and batteries
51. Electric current
52. Ohm's Law
53. Direct current circuit
54. Variable resistors and nonlinear resistors
55. Work and power of current

## XI. Magnetism

56. Magnetic field
57. Electromagnets
58. Electromagnetic force
59. Electric motor
60. CRT and an oscilloscope

## XII. Alternating current

61. Electromagnetic induction
62. Alternating current and a generator
63. Transformer
64. Transfer of electrical energy
65. Current in a household
66. Electric energy and methods of energy saving

## XIII. Electronics

67. Diode
68. Power supply units and rectifiers
69. Light and current
70. Transistor
71. Logic gates
72. Digital systems

## XIV. Oscillations and mechanical waves

73. Oscillations
74. Resonance
75. Mechanical waves
76. Reflection and refraction of waves
77. Seismic waves
78. Diffraction and interference of mechanical waves

## XV. Sounds

79. Sound
80. Infrasound and ultrasound
81. Interference of sound waves
82. Sounds in music
83. Sound intensity
84. Doppler effect

## XVI. Electromagnetic waves

85. Electromagnetic waves
86. Laser
87. Diffraction and interference
88. The ranges of electromagnetic waves
89. Threats related to electromagnetic waves
90. Application of waves for communication

## XVII. Light

91. Reflection of light
92. Spherical mirrors
93. Refraction of light
94. A lens
95. Optical instruments
96. The eye
97. Colours

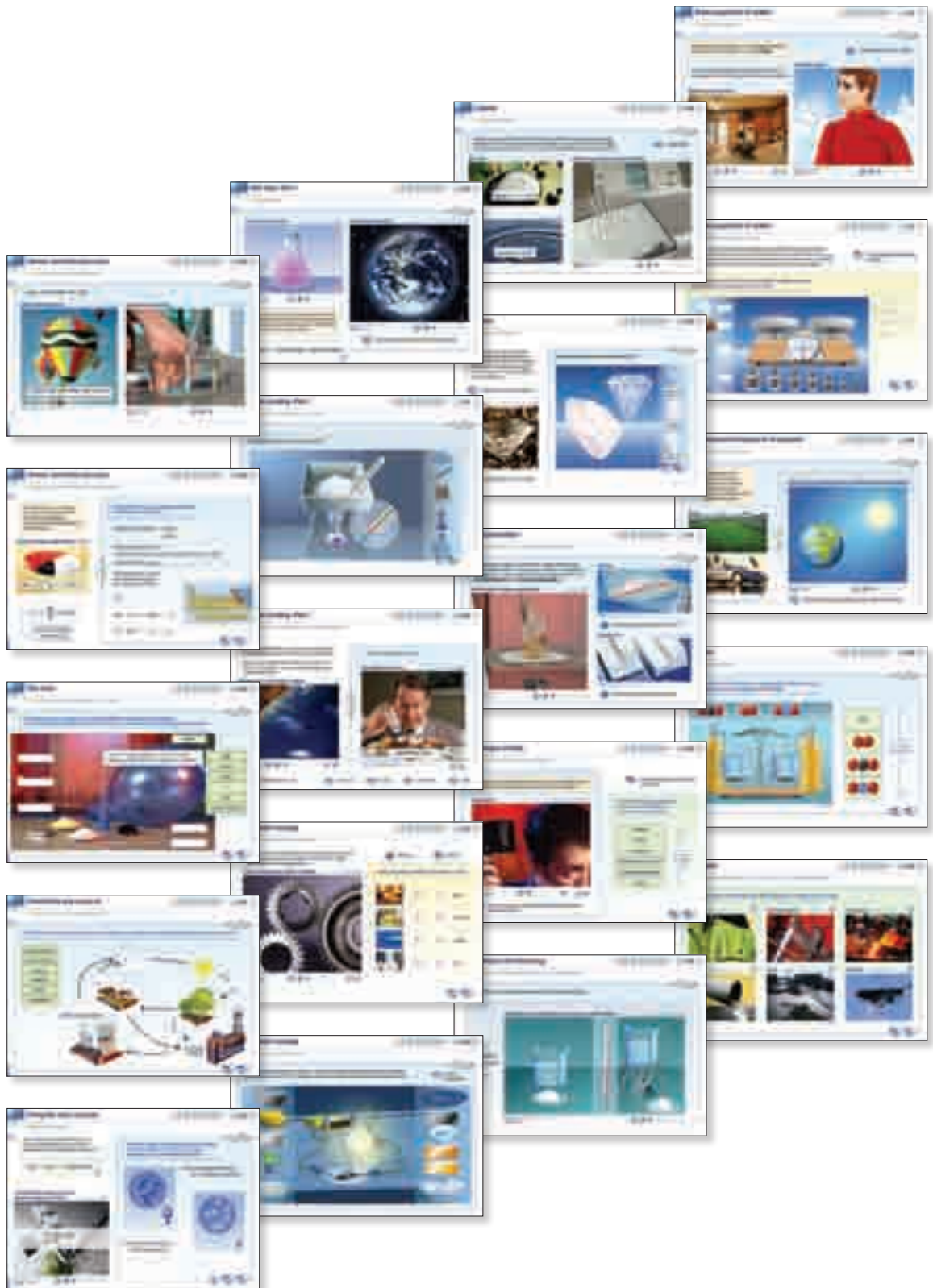
## XVIII. Nuclear physics

98. Structure of an atom
99. Nuclear radiation
100. Decay law
101. Affect of radiation on live organisms
102. Application of radioactivity
103. Nuclear fission
104. Nuclear energy
105. Nuclear fusion

## XIX. Earth and the Universe

106. The Solar System
107. The Moon
108. Eclipses
109. The structure and the evolution of stars
110. Galaxies
111. The Universe

# Chemistry - Lower Secondary level



## I. States of matter

1. Basic properties of matter
2. Gases
3. Liquids
4. Solids
5. Changes of state
6. Physical changes accompanying heating and cooling
7. Diffusion and dissolving
8. Gas laws. Part I
9. Gas laws. Part II

## II. Elements, compounds and mixtures

10. Elements
11. Chemical compounds
12. Mixtures

## III. Atomic structure

13. Early atomic theories
14. The structure of the atom
15. Relative atomic mass
16. Continuous and line spectra
17. The Bohr model of the atom
18. The electron configuration of an atom

## IV. Bonding

19. Ionic bonding. Part I
20. Ionic bonding. Part II
21. Covalent bonding. Part I
22. Covalent bonding. Part II
23. Metallic bonding
24. Alloys
25. Simple and giant molecular solids
26. Allotropes

## V. Representing chemical reactions

27. Chemical and physical change
28. Chemical equations
29. Reaction types

## VI. Quantitative aspects of chemical reactions

30. Atomic and molecular mass
31. The mole
32. Using the mole concept

## VII. Acids, bases and salts

33. Properties of acids
34. Properties of bases
35. Indicators and pH
36. Neutralisation reactions
37. Salts
38. Reactions of acids and bases
39. Acid-base titration

## VIII. Water and water solutions

40. Properties of water
41. Solubility in water
42. Natural waters
43. Colloids. Washing in water

## IX. The periodic table and chemical properties of the elements

44. The periodic table
45. Noble gases
46. Alkali metals
47. Reactions of alkali metals
48. Alkaline earth metals. Group 2
49. Halogens. Group 17
50. Reactions of the halogens
51. Transition elements

## X. Reactivity of metals

52. The reactivity series
53. Predicting reactions involving metals
54. Electrochemical cells

## XI. Electrolysis

55. Conductivity of electrolytes
56. Electrolysis
57. Applications of electrolysis and calculations connected with electrolysis

## XII. Organic chemistry

58. Alkanes
59. Isomerism of alkanes
60. Alkenes
61. Alcohols
62. Carboxylic acids

## XIII. Chemical reactions

63. Endothermic and exothermic reactions
64. Reversible reactions and chemical equilibrium
65. Reaction rate
66. Factors affecting reaction rate
67. Catalysts
68. Enzymes – biological catalysts

## XIV. Useful products from organic sources

69. Fossil fuels and crude oil
70. Cracking and combustion of hydrocarbons
71. Polymers
72. Environmental impact of oil products

## XV. Useful products from rocks

73. Metals from metal ores
74. Iron
75. Aluminium
76. Copper and titanium
77. Industrial uses of limestone
78. Sulphur and sulphuric(VI) acid

## XVI. Useful products from air

79. Air
80. Ammonia and nitric acid
81. Fertilisers

## XVII. Food and drugs

82. Carbohydrates
83. Proteins
84. Fats
85. Food and drugs

## XVIII. Chemistry and the Earth

86. The structure of the Earth
87. Tectonic plates
88. Tectonic movements, earthquakes and volcanoes
89. Igneous rocks
90. Sedimentary rocks. Part I
91. Sedimentary rocks. Part II
92. Metamorphic rocks and circulation of rock matter
93. The atmosphere
94. Oceans

## XIX. Laboratory techniques and analytical tests

95. Handling liquids
96. Handling solids. Heating
97. Gases: handling and laboratory tests
98. Testing for ions

## XX. Safety in the chemical laboratory

99. Safety in the chemical laboratory

# Biology - Lower Secondary level



## I. The cell – the basic unit of living organisms

1. Structure of plant and animal cells
2. Microscopes and the size of cells
3. Chemical composition of cells
4. The nucleus as a store of genetic material
5. Cell division
6. Cell specialization
7. Transport across membranes
8. Metabolic transformations in a cell
9. Plant tissues
10. Animal tissues

## II. The diversity of living organisms

11. Classification of organisms
12. Prokaryotes, protists and fungi
13. Plants
14. Invertebrates
15. Reproduction in invertebrates
16. Vertebrates
17. Reproduction in vertebrates
18. Viruses

## III. Structure and functions of the human organism

### 1. Circulation

19. Blood
20. Blood vessels
21. Blood groups and the Rhesus factor
22. The circulatory system
23. Effects of physical effort on the functioning of the circulatory system
24. Risk factors for heart attack

### 2. Nutrition

25. Nutrients
26. The human alimentary canal
27. Digestion
28. Absorption

### 3. Respiration

29. The respiratory system
30. Cellular respiration and energy production

### 4. Nervous system

31. The nervous system as a receptor of environmental stimuli
32. Nervous system
33. The peripheral nervous system
34. Reflex responses of the nervous system
35. Sensory organs
36. The eye and the ear

### 5. Hormones

37. Hormones and endocrine glands
38. Hormonal regulation of metabolic processes
39. Sex hormones

## 6. Human locomotion system

40. The skeletal system
41. Skeletal muscles

## 7. Homeostasis

42. Homeostasis
43. Regulation of the amount and composition of systemic fluids by the kidneys
44. Thermoregulation

## 8. Human reproduction

45. The reproductive system
46. Development of the human embryo

## 9. Health and diseases

47. The human immune system
48. Vaccinations
49. Bacterial diseases
50. Viral diseases
51. Human immunodeficiency virus (HIV)
52. Antiseptics and antibiotics
53. Parasitic diseases
54. Effects of drugs, cigarettes and alcohol on the organism

## IV. Life processes in plants

### 1. Plant nutrition

55. Photosynthesis
56. Mineral nutrition in plants
57. Crop production
58. Carnivorous plants

### 2. Plant reproduction

59. Plant reproduction
60. Seed germination and plant growth

### 3. Transport in plants and plant movements

61. Water transport in plants
62. Transport and accumulation of organic substances in plants
63. Responsiveness and plant movements

## V. Variation, heredity and evolution

### 1. Variation in organisms

64. Variation of organisms
65. Reproduction and variation
66. Mutations as a source of variation in organisms

### 2. Heredity

67. Heredity according to Mendel
68. The principles of sex inheritance in humans
69. The chromosomal theory of inheritance
70. Genetic diseases
71. Inheritance of blood groups in humans
72. Nucleic acids
73. The gene as a structural and functional unit of DNA
74. Mutations as changes in DNA

## 3. Evolution

75. The origin of life on Earth
76. Charles Darwin and the theory of evolution
77. Laws of evolution and speciation
78. The history of life on Earth
79. Human evolution

## VI. Biotechnology and genetic engineering

### 1. How we combat microorganisms and how we use them

80. Bacterial growth
81. Protecting food from spoilage
82. Biotechnology past and present
83. Industrial uses of bacteria

### 2. Genetic engineering

84. Genetic engineering and its applications in biotechnology
85. Other applications of genetic engineering
86. Genetic modification of organisms

## VII. Living organisms and their environment

87. The individual and the population
88. Competition. Predation
89. Symbiosis
90. Life on land
91. Life in water
92. Adaptations of organisms to the environment
93. Different modes of feeding in mammals
94. Humans and environment
95. Environmental pollution
96. The greenhouse effect and the ozone hole
97. Conservation of natural resources

## VIII. The flow of energy and matter, information exchange

98. Ecosystem
99. Food chains
100. Information in nature
101. Biogeochemical cycles

# Mathematics - Upper Secondary level



## I. Numbers (1)

1. Surds

## II. Quadratic functions

2. Quadratic functions, graphs
3. Factorisation of quadratic functions
4. Quadratic equations
5. Simultaneous equations
6. Inequalities
7. Quadratic inequalities

## III. Polynomials

8. Presentation of polynomials
9. Algebraic manipulation of polynomials
10. Division of polynomials
11. The factor and remainder theorems
12. Factorisation of polynomials
13. Factorisation and roots of polynomials

## IV. Graphs of polynomials

14. Sketching graphs
15. Graphical solution of equations (1)
16. Graphical solution of equations (2)
17. Graphical solution of inequalities (1)
18. Graphical solution of inequalities (2)
19. Translations and graphs

## V. Coordinate geometry (1)

20. Equation of a straight line
21. Parallel and perpendicular lines
22. Coordinate geometry of a circle
23. The tangent
24. The normal
25. Intersection points (1)
26. Intersection points (2)

## VI. Differentiation (1)

27. The derivative
28. Differentiation of simple functions
29. Differentiation of polynomials
30. Finding gradients, tangents and normals
31. Monotonicity
32. Local extrema, stationary points, critical points
33. Finding local extrema
34. Finding maximum and minimum values
35. Second-order derivatives

## VII. Integration (1)

36. The anti-derivative
37. Integrating
38. The definite integral
39. Area under the curve

## VIII. Numbers (2)

40. Laws of indices – rational exponents

## IX. Graph transformations

41. Transformations of graphs (1)
42. Transformations of graphs (2)

## X. Sequences and series

43. Sequences
44. Arithmetic sequence
45. Arithmetic series
46. Geometric sequence
47. Geometric series
48. Infinite convergent geometric series
49. The binomial expansion

## XI. Trigonometry (1)

50. General angles
51. General angles, angle measures
52. Basic trigonometric functions
53. Graphs of trigonometric functions
54. Simple trigonometric equations
55. Solving simple trigonometric equations
56. The area of a triangle
57. The sine rule
58. The cosine rule
59. Measuring the circle

## XII. Exponentials and logarithms

60. Exponential functions
61. The logarithm
62. Basic exponential equations
63. Exponential inequalities

## XIII. Differentiation (2)

64. Derivatives of powers with rational exponent

## XIV. Integration (2)

65. Integrals of powers with rational exponent
66. Approximation of the area under a curve

## XV. Functions

67. Functions – basic notions
68. Composition of functions
69. Inverse function
70. The modulus function
71. Transformation of graphs

## XVI. Trigonometry (3)

72. Inverse trigonometric functions
73. Other trigonometric functions
74. Identities for trigonometric functions

## XVII. Exponentials and logarithms

75. The natural exponential function
76. The natural logarithmic function

## XVIII. Differentiation (3)

77. Derivatives of exponential and logarithmic functions
78. Derivatives of trigonometric functions
79. Differentiation rules (1)
80. Differentiation rules (2)

## XIX. Integration (3)

81. Integration of selected functions
82. Integration methods (1)
83. Integration methods (2)
84. Volumes of revolution

## XX. Numerical methods

85. Zeros of a function
86. Approximate solution of equations
87. Numerical integration – mid-ordinate rule
88. Numerical integration – Simpson's rule

## XXI. Rational functions

89. Rational expressions
90. Rational functions
91. Algebraic division
92. Partial fractions

## XXII. Coordinate geometry (2)

93. Equations of curves
94. Parametric equations of curves

## XXIII. Sequences and series

95. Binomial series
96. Expansion of rational functions

## XXIV. Trigonometry (3)

97. Trigonometric functions of the sum and difference of angles (1)
98. Trigonometric functions of the sum and difference of angles (2)
99. Double-angle formulas

## XXV. Exponentials and logarithms

100. Exponential growth and decay

## XXVI. Differentiation and integration

101. Differential equations
102. Equations with separable variables
103. Implicit differentiation
104. Parametric differentiation
105. Tangents and normals for implicitly or parametrically defined curves
106. Integration using partial fractions

## XXVII. Vectors

107. Vectors
108. Algebraic operations on vectors
109. Position vectors
110. Vector equations of lines in 2-D
111. Vector equations of lines in 3-D
112. The scalar product (1)
113. The scalar product (2)
114. Perpendicular distance from a point to a line

# Physics - Upper Secondary level



## I. Statics

1. Forces
2. Addition of forces
3. Torque
4. Equilibrium
5. Forces and moments of forces in constructions

## II. Kinematics

6. Uniform motion
7. Accelerating motion
8. Distance in accelerating motion
9. Description of motion in terms of vectors
10. Circular motion
11. Projectile motions

## III. Dynamics

12. The First and the Third Law of Motion
13. Momentum
14. Newton's Second Law of Motion
15. Forces in curvilinear motions
16. Friction
17. Air drag

## IV. Energy

18. Work and energy
19. Potential energy and kinetic energy
20. Internal energy
21. Power
22. Collisions
23. Simple machines

## V. Rotational motion

24. Angular velocity and angular acceleration
25. Newton's second law for rotational motion
26. Angular momentum
27. Energy of rotational motion

## VI. Gravitational field

28. Gravitational force
29. Gravitational acceleration
30. Potential energy
31. Potential
32. Satellites

## VII. Matter

33. Density
34. Stresses
35. Hooke's Law
36. Temperature
37. Heat transfer
38. The states of matter

## VIII. Mechanics of Fluids

39. Hydrostatic pressure
40. Atmospheric pressure
41. Pascal's Law
42. Archimedes' Principle
43. Bernoulli's Principle
44. Movement of bodies in liquids

## IX. Gas Laws

45. Gas transformations
46. The Ideal Gas Equation
47. Kinetic theory of gases
48. Molar specific heat of a gas
49. Adiabatic transition

## X. Thermodynamics

50. The First Law of Thermodynamics
51. Heat engine
52. Specific heat
53. Sources of heat
54. The Second Law of Thermodynamics

## XI. Electrostatics

55. Coulomb's Law
56. Electric field
57. Potential
58. Capacitance
59. Capacitors

## XII. Direct current

60. Electric current
61. Electrical resistance
62. Resistors
63. Electromotive force
64. Work and power of electric current

## XIII. Magnetism

65. Magnetic field
66. The magnetic field around current-carrying wires
67. Electromagnetic force
68. Application of electromagnetic forces
69. The movement of a charge in a magnetic field

## XIV. Alternating current

70. Phenomenon of electromagnetic induction
71. Generator and alternating current
72. Transformer
73. Transmission of electrical energy
74. Current in a household

## XV. Electronics

75. Electronics
76. Light and current
77. Transistors and gates
78. Digital systems

## XVI. Harmonic motion

79. Oscillations
80. Pendulum
81. Energy of oscillations
82. Resonance

## XVII. Mechanical waves

83. Mechanical waves
84. Reflection and refraction of waves
85. Diffraction and interference of mechanical waves
86. Oscillations of a string
87. The intensity of a wave
88. The Doppler effect

## XVIII. Electromagnetic waves

89. Electromagnetic waves
90. Diffraction and interference
91. Polarisation
92. Application of waves for communication
93. Signal encoding

## XIX. Optics

94. Reflection and refraction of light
95. Spherical mirrors
96. Lenses
97. Optical instruments
98. An eye

## XX. Atomic physics

99. Radiation of objects
100. External photoelectric effect
101. Emission and absorption spectra
102. Electron energy levels in an atom
103. X-rays
104. Waves of matter

## XXI. Nuclear physics

105. The structure of atomic nucleus
106. Nuclear radiation
107. Decay law
108. Stability of the nuclei
109. Nuclear fusion
110. Nuclear fission
111. Elementary particles

## XXII. Astrophysics

112. The Solar System
113. Classification of stars
114. Evolution of stars
115. Galaxies

## XXIII. Theory of relativity

116. The speed of light
117. Time and distance
118. Mass, energy and momentum
119. General theory of relativity

# Chemistry - Upper Secondary level



## I. Atomic structure

1. Structure of the atom
2. Development of atomic theory. Radioactivity
3. Atomic spectra
4. Electron configuration of atoms

## II. Bonding

5. Types of bonding
6. Electronegativity and polarity
7. Molecular shapes
8. Valence bond theory and hybridisation

## III. Phases and phase changes

9. States of matter
10. Phase changes
11. Gas laws
12. Intermolecular forces
13. Structure of solids

## IV. Stoichiometric calculations

14. Mole
15. Chemical equations
16. Practical importance of the mole
17. Concentration

## V. Periodic table

18. The periodic table of the elements
19. The trends in the properties of the elements in Period 3
20. Periodic trends in the chemical properties of elements
21. s-Block elements
22. Chemical properties of s-block elements
23. Elements of Group 17
24. Reactions of halogens

## VI. Oxidation and reduction

25. Oxidation state
26. Redox reactions
27. Extraction of metals. Part I
28. Extraction of metals. Part II

## VII. Electrochemistry

29. Voltaic cells
30. Standard electrochemical potential
31. Electrochemical series

## VIII. Thermodynamics

32. Enthalpy change and calorimetry
33. Standard enthalpy change. Hess's law
34. Born-Haber cycle
35. Enthalpy changes in the solution process
36. Mean bond enthalpies
37. Entropy
38. Free energy

## IX. Reaction kinetics

39. Reaction rate
40. Collision theory
41. Effect of concentration on the reaction rate. Rate equation

42. Effect of concentration on the reaction rate. Graphical methods
43. Effect of temperature and catalyst on the reaction rate
44. Catalysts

## X. Chemical equilibria

45. Chemical equilibrium and equilibrium constant
46. Factors affecting the chemical equilibrium
47. Chemical equilibrium in a gas phase

## XI. Acids, bases and salts

48. Dissociation of acids, bases and salts
49. Brønsted-Lowry theory of acids and bases
50. pH as the universal acidity measure
51. Weak acids and weak bases
52. Salts in water solution
53. Buffers
54. Acid-base titration
55. Titration curves

## XII. Transition metals

56. Electron configuration and periodic trends of transition elements
57. Oxidation states of transition elements
58. Transition metal complexes

## XIII. Reaction of metal ions in water solution

59. Acid-base reactions of metal ions
60. Ligand exchange reactions

## XIV. Hydrocarbons

61. Petroleum as the source of hydrocarbons
62. Hydrocarbons as fuel
63. Alkanes and cycloalkanes
64. Chemistry of alkanes and cycloalkanes
65. Alkenes
66. Alkene reactions

## XV. Haloalkanes, alcohols and epoxides

67. Haloalkanes
68. Reactions of haloalkanes
69. Alcohols
70. Ethanol
71. Properties of alcohols

## XVI. Compounds with the carbonyl group

72. Aldehydes and ketones
73. Reactions of aldehydes and ketones
74. Carboxylic acids
75. Functional derivatives of carboxylic acids

## XVII. Aromatic compounds

76. Benzene
77. Electrophilic substitution

## XXIII. Organic compounds of nitrogen

78. Structure and properties of amines
79. Amines and amides: reactions and preparation
80. Amino acids

## XIX. Biologically important chemical compounds

81. Fats and sugars
82. Proteins and nucleic acids

## XX. Polymers

83. Polymer types. Addition polymers
84. Condensation polymers

## XXI. General topics in organic chemistry

85. Organic molecules
86. Naming organic compounds
87. Isomerism
88. Organic reactions
89. Analytical tests in organic chemistry

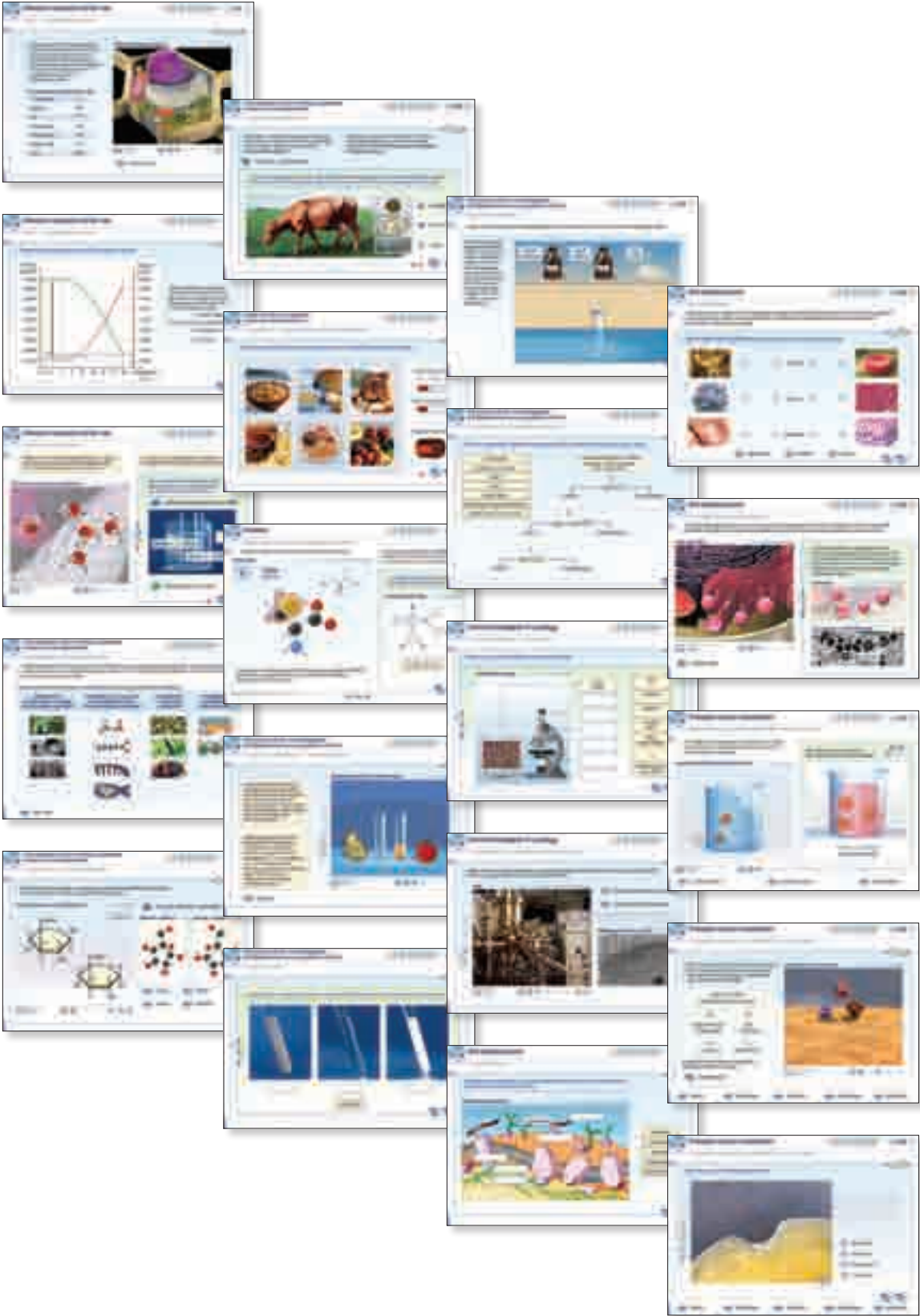
## XXII. Spectrometric techniques

90. Infra-red spectroscopy. Part I
91. Infra-red spectroscopy. Part II
92. Mass spectrometry. Part I
93. Mass spectrometry. Part II
94. Nuclear magnetic resonance (NMR) spectroscopy. Part I
95. Nuclear magnetic resonance (NMR) spectroscopy. Part II
96. Determination of molecular structure
97. Absorption of visible light. Colorimetry

## XXIII. Environmental pollution by chemical products

98. Pollution of air
99. Pollution of water
100. Pollution of land

# Biology - Upper Secondary level



## I. Chemistry of organisms

1. Chemical elements of the cell
2. Carbohydrates: their structure, properties, occurrence and importance
3. Lipids: structure, properties, occurrence and importance
4. Proteins
5. Biochemical tests, chromatography, electrophoresis and separation of tissues

## II. Basics of cytology

6. Morphology of prokaryotic and eukaryotic cells as seen under the light microscope
7. Current techniques in cytology
8. Cell ultrastructures
9. Specialization of cells
10. Transport across membranes
11. Cell division – mitosis
12. Cell division – meiosis (reduction division)

## III. Taxonomy

13. Taxonomy
14. Prokaryotes – simple organisms with no nucleus
15. Protista
16. Fungi
17. Plants
18. Animals – the invertebrates
19. Animals – the vertebrates

## IV. Metabolism

20. Enzymes as biocatalysts
21. Industrial uses of enzymes
22. Uses of enzymes in medical laboratories
23. Metabolic transformations
24. Autotrophic nutrition and photosynthesis
25. Biochemistry of photosynthesis
26. Factors affecting photosynthesis
27. Cell respiration
28. Aerobic respiration

## V. Nervous coordination

29. Excitability of neurones
30. Transmission of nerve impulses from cell to cell – synapses
31. Structure of the human nervous system
32. Involuntary functioning of the nervous system
33. Autonomic nervous system
34. Receptors
35. The eye
36. Animal behaviour as a form of adaptation to the environment

## VI. Food ingestion and digestion

37. Heterotrophic nutrition
38. Nutrients
39. Nutritional requirements
40. The human alimentary system
41. Food processing in the alimentary canal
42. Absorption of digestion products
43. Digestion of food rich in cellulose

## VII. Internal transport

44. Transport of substances in animals
45. Structure and functions of the heart
46. Transport of substances in plants
47. Transpiration

## VIII. Respiratory gas exchange

48. Respiratory surfaces
49. Transport of respiratory gases
50. Physiology of the human respiratory system

## IX. Physiology of muscles

51. Physiology of muscle contractions
52. Chemistry of muscle contraction

## X. Reproduction

53. Physiology of the human reproductive system
54. Fertilization
55. Development of the human embryo
56. Birth control in humans and animals
57. Growth and development of the organism
58. The ageing process
59. Sexual reproduction in plants

## XI. Homeostasis

60. The concept of homeostasis
61. Hormonal regulation
62. Thermoregulation
63. Regulation of glucose level in the blood
64. The liver as a homeostatic organ
65. Role of the kidneys in regulating water-electrolyte balance – Part 1
66. Role of the kidneys in regulating water-electrolyte balance – Part 2
67. Regulation of water loss in desert animals

## XII. Human health

68. Characteristics of a healthy organism
69. The concept of disease
70. Bacterial diseases
71. Parasitic diseases
72. AIDS – an example of a viral disease
73. Human immunity
74. Coronary heart disease
75. Cancer
76. Actions of different groups of medicines

## XIII. Genetic information

77. DNA – the carrier of genetic material
78. Organization of DNA in chromosomes
79. Cloning of organisms
80. Genetic code and protein synthesis
81. Mutations
82. Chromosomal mutations

## XIV. Genetic engineering

83. Genetic engineering techniques
84. Medical applications of genetic engineering
85. Transgenic organisms

## XV. Genetics according to Mendel

86. Inheritance of a single trait
87. Inheritance of two or more traits
88. Inheritance of sex

## XVI. Variation in organisms

89. The nature of variation
90. Factors influencing variation
91. Elements of population genetics
92. Speciation – the formation of species
93. Different modes of speciation

## XVII. Population

94. Features of populations
95. Biodiversity
96. The ecosystem – an organized and functional unit of the natural environmental
97. Energy flow and the circulation of matter
98. Ecological succession
99. Effects of human activity on ecosystems
100. Agriculture – the conservation of biodiversity

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