Rationalization of School Curriculum

Background

The conventional teacher-centered and rote learning form of education has served us well through ages. As the education system in Bhutan embraces the 21st Century education framework and principles, it warrants a paradigm shift in curriculum design and development, including the pedagogy, commensurate the competency based learning. An approach, which underscores that learning in the 21st Century is for the development of competencies through active engagement of learners in learning experiences, guided by formation and utilization of "working knowledge". This empowers learners to take responsibilities of their learning and develop "portable skills or soft skills," such as critical thinking, creativity, communication and collaboration, vital for all as individuals with unique talent and competencies. The current culture of curriculum design and practices in schools, however, do not render condition to facilitate realisation of the national aspiration of nurturing "nationally rooted and globally competent" citizen.

Amongst others, it has always been a concern for REC on the extent, relevancy and quality of the curriculum in all subjects. Thus, in order to facilitate quality learning for 21st Century education, REC has initiated major curriculum reform in all subjects.

Rationale

The Bhutan Education Blueprint 2014-2024 indicated that the existing curriculum was 'heavy'. This was echoed as one of the major pointers in the National School Curriculum Conference 2016 that the curriculum was 'vast'. These findings led to the need for curriculum "thinning" [Resolution 3.1.10 (IV)]. In response to these findings, REC started the rationalization of the existing curriculum by reviewing and screening out the obsolete and irrelevant content, and updating them with the most recent information and also rectifying errors in the textbooks. Therefore, some portions of the syllabi from several subjects, for instance, have been dropped. The rationalization or thinning of curriculum is one of the important considerations made while developing new textbooks based on new curriculum frameworks.

The curriculum rationalization process also aligns very well with Resolution 13 of the National Education Conference 2018 of "Doing away with the Saturday classes". The para 13.4 of the resolution requires 'REC to work on curriculum thinning and review of time allocation for each subject'. This resolution has further facilitated REC to expedite the curriculum rationalization and review the time and period allocation for each subject.

Rationalization of the school curricula is based on the following strategies:

i. Review the goals and outcomes of each subject to identify topics, chapters, learning activities, exercises and assessment.
ii. Develop rationalized syllabus for each subjects ensuring conceptual linkages and progression within the chapter or topic in the textbooks.
iii. Minimize lexical density in text by reducing heavy textual materials from the textbooks.

iv. Remove topics, learning activities or assessment items, which are redundant, overlapping, irrelevant or inappropriate.
v. Delete irrelevant or inappropriate illustrations or diagrams, and examples from the text.
vi. Update and align the content width and depth with the teaching time available for each subject.
vii. The revised syllabi for each subject are categorised and compiled under four subject b classifications, namely STEM, Social Sciences, Language, and TVET & Commercial Studies.

The review of the instructional time allocation is based on the following criteria:

i. Maintain the instructional time requirement at the international standard.
ii. Maintain gradual increase of instructional time across most of the key stages.
iii. Reduce the instructional time for each subject across the grades based on the doing away of the Saturday classes.
iv. Allocate time for personal development learning areas, such as HPE, Arts Education, Values Education, CGC, TVET Program (clubs and PVOP).
v. Non-curricular activities and programmes are to be conducted outside the instructional hours.
vi. Calculate 150 actual curricular instructional days (excluding examination days in June and November months) in an academic year based on 5 working days per week.
vii. Calculation of instructional time is based on 8 periods a day of 40 minutes each.

Conclusion

Instructional time refers to the actual contact time in the classroom. This is the minimum time available for the delivery of the curriculum including assessment. Instructional Time equals to number of days multiplied by number of periods per day times duration of one period (180 x 8 x 40). The rationalization of the curriculum is based on 150 days of the actual instructional time.

Instructional days are the total number of days within which the curricular activities are conducted. Within these days, a maximum of 5.33 hours (320 minutes) are available for actual classroom instruction per day. This calculation is based on 8 periods a day of 40 minutes each. The average instructional time in the OECD countries ranges from 799 to 915 hours per year. This includes all the educational activities that happen in the school in a day. However, the calculation of instructional time for the rationalized curriculum is based on the actual contact time for curriculum delivery, which has resulted in more instructional time than in OECD countries.

Lastly, it must be noted that the instructional time and days are suggested guide. Thus, it is envisaged that schools will make adjustment in instructional time as deemed applicable.

Class: IX **Subject: Biology**

Sl. No.	Chapters	Time (mins)	Weighting (%)	Changes (deletion, addition, or change in the sequence)	Reasons
1	Chapter 0: Introduction	70	0%		
2	Chapter 1: The Cell	390	11%		
3	Chapter 2: Green Plans	740	23%	Remove **functions of essential elements** from the instruction (sub-chapter: Transportation Systems in Plants)	This topic seems irrelevant as well as incongruent with the scope defined by the very chapter
4	Chapter 3: The Digestive System	160	7%	Teach **mixing** and **moments**, i.e., **swallowing** and **peristalsis** as part of **Ingestion** while **segmentation** as part of **digestion** and **absorption** (Sub-chapter: Human Digestive System)	These physical movements help in ingestion, digestion, and absorption
5	Chapter 4. The Circulatory System	265	7%	Remove **functions of cardiovascular system** from the instruction (Sub-chapter: Physiology of Cardiovascular System)	It is a mere repetition of the concepts spelled out in the introductory note of preceding chapter, i.e., Components of the Cardiovascular System
6	Chapter 5: The Respiratory System	255	6%	Remove **types of respiration** from the instruction (Sub-chapter: Human Respiratory system)	The concepts are beyond the scope of the chapter
7	Chapter 6: The Nervous System	390	8%		

8	Chapter 7: The Endocrine System	200	6%	1. Remove **menstrual cycle** from the instruction (Sub-chapter: Endocrine System) 2. Remove **hormones and their control of menstrual cycle** from the instruction (Sub-chapter: Endocrine System) 3. Teach about the hormones secreted by testes and ovaries- Sex Hormones (estrogen, progesterone, and testosterone) (Sub-chapter: Endocrine System)	1. The concepts sound more of general physiology of female reproductive system. Moreover, the role of gonadotropins specified in are just the repetition of the preceding topic(s) 2. It also a mere repetition of the preceding topic(s) 3. Testes and ovaries also major endocrine glands
9	Chapter 8: Variation, Genetics, and Evolution	730	16%		
10	Chapter 9: Health and Harmful Substances	200	6%		
11	Chapter 10: Organisms in their Environment	200	10%	1. Remove **predation and parasitism** given as part of the topic **Feeding interaction** from the instruction (Sub-chapter: Interactions and Adaptations in their Environment)	1. It is a mere replication of the aspects spelled out in topic "**predator and prey relationship** and **symbiosis"** as well as those given in activity 10.1

				2. Teach **decomposition** after **symbiosis** (Sub-chapter: Interactions and Adaptations in their Environment) 3. Remove **nutrient cycle** from the instruction (Sub-chapter: Interactions and Adaptations in their Environment) 4. Remove **homeostasis** from the instruction. (Sub-chapter: Interactions and Adaptations in their Environment)	2. It also one of the forms of ecological interactions 3. It is a mere duplication of those given in class 9 chemistry 4. It is more or less identical to those spelled out in the preceding chapter, i.e., Homeostasis and Body Control System.
		3, 600 minutes	**100%**		

The total time required to complete the topics is 3, 600 minutes or 90 periods of 40 minutes each.

Class: X **Subject: Biology**

Sl.No.	Chapters	Time (mins)	Weighting (%)	Changes (deletion, addition, or change in the sequence)	Reasons
1	Chapter1: The Cell- The Unit of Life	280	10%	Remove **table 1.1: The parts of eukaryotic cell and their main features and functions** from the instruction. *However, while teaching about eukaryotic cell, students must be told that they already learnt the concepts given in table 1.1 in class 9 Biology* (Sub-chapter: Types of Cell)	The concepts spelled out in table 1.1 are just the repetition of those given in class 9 biology.
2	Chapter 2: Green plants	600	17%	1. Remove **transportation of food material** from the instruction (Sub-chapter: Transportation System in plants) 2. Remove **mineral nutrient requirement in plants and essential mineral elements** from the instruction (Sub-chapter: Transportation System in plants) 3. Remove **Importance of water to the plants** from the instruction (Sub-chapter: Transportation System in plants)	1. It is a mere duplication of those spelled out in class 9 biology 2. The concepts are beyond the scope of the chapter 3. The concepts are incongruous with the scope defined by the chapter

3	Chapter 3: Human as Organisms	870	18%		
4	Chapter 4: Response and Coordination in Human	450	14%	1. Remove **terms used to describe feedback system** from the instruction (Sub-chapter: Hormones) 2. Remove **symptoms of diabetics, treatment of diabetics, and Effect of insulin** given on page number 117 from the instruction (Sub-chapter: Hormones) 3. Remove **adrenaline and sex hormones** from the instruction**.** *However, the role and adverse effects of* **anabolic steroids** *must be taught* (Sub-chapter: Hormones)	1. The terms do not seem to aid in the conceptualisation of feedback mechanism 2. A mere repetition of the preceding topics 3. A mere repetition of those given in class 9 biology
5	Chapter 5: Micro-organisms, Diseases, and Drugs	400	12%		
6	Chapter 6: Variation,	580	16%	Remove **Importance of mutations** from the instruction	The concepts make the chapter content laden and taxing

	Inheritance, Evolution			(Sub-chapter: Variation)	
7	Chapter 7: Living Things in their Environment	420	13%		
		3, 600 minutes	**100%**		

The total time required to complete the topics is 3, 600 minutes or 90 periods of 40 minutes each**.**

Class: XI Subject: Biology

Sl No	**Chapter**	**Time (mins)**	**Weighting (%)**	**Remove the following topics or chapters, or paragraphs from the instruction. However, please note that those that need to focus, change, add in, or arrange accordingly during teaching are spelled out in caps or capital letters**	**Reasons**
1	Chapter 1: Biological Molecules	600	6%	1. Biological compounds 2. Water 3. Biological importance of water 4. Functions or role of monosaccharides 5. Function of disaccharides 6. Functions of disaccharides 7. Functions of storage polysaccharides 8. Use of cellulose 9. Functions of mucopolysacharrides 10. Functions of polysaccharides	The chapter per see appears bulky, voluminous, textual, and content laden with high lexical density. Moreover, the topics listed seems vague, generic, repeated, redundant, or incongruent with the scopes of the chapter

				11. Properties of fats 12. Composition of waxes 13. Some important phospholipids (page 26-27) 14. Sterols (TEACH THE CONCEPTS OF CHOLESTEROL) 15. Steroids 16. Fat soluble vitamins 17. Bile salts 18. Essential oils and vitamins 19. Icanosides 20. Functions of fats/lipids 21. Properties of proteins 22. Classification of proteins (on the basis of shape and constitution) 23. Biological functions of proteins 24. Cyclic AMP 25. Coenzymes	
2	Chapter 2: Enzymes	330	5%		
3	Chapter 3: Respiratory System	330	4%	1. Types of respiration-aerobic and anaerobic respiration 2. Features of gas exchange surface- Surface area to the volume ratio of respiratory surface and need for the development of internal gas exchange surface 3. Oxygen carrying capacity	The concepts are insignificant, repeated, content laden, and beyond the scope of the chapter
4	Chapter 4: Transport System	451	6%		
5	Chapter 5: Homeostasis	345	5%	1. Control system	

				2. Homeostasis (TEACH JUST THE CONCEPT OR DEFINITION OF HOMEOSTASIS) 3. Role of organ systems in maintaining homeostasis	The concepts are generic and content laden
6	Chapter 6 : Chemical coordination	345	5%	1. Types of hormones 2. Chemical nature of hormones 3. Functions of hormones 4. Mechanism of hormone action 5. Stimuli for the release of hormones 6. Feedback control of the endocrine activity	The concepts are just the repetition of other topics within the chapter and content laden
7	Chapter 7: Nervous Coordination	457	6%		
8	Chapter 8: Brain and Behavior	345	5%	Animal's Behavior	The concepts are overly abstract, content laden, and more of psychology oriented
9	Chapter 9: Immune System	345	5%	Activation of adaptive immunity (clonal selection and Role of memory cells in long term immunity)	The concepts are generic and incongruent with the scope of the topic
10	Chapter 10: Transport System in Plants	463	5%	1. Aspects of imbibition 2. Importance of imbibition in plants 3. Importance of diffusion 4. Significance of osmosis 5. Significance of plasmolysis 6. Significance of turgor pressure 7. Objection to root pressure theory 8. Guttation to support root pressure theory 9. Objection to capillary force theory	The chapter per see appears bulky, voluminous, arduous, and content laden

				10. Objection to transpiration pull theory 11. Objection to starch sugar hypothesis	
11	Chapter 11: Control System in Plants	394	5%	1. Responses in plants 2. Requirement for vernalisation	The concepts are generic and vague
12	Chapter 12: The Cell Cycle	309	5%		
13	Chapter 13: Asexual Reproduction	312	4%	1. Purpose of reproduction 2. Basic features of asexual reproduction 3. TEACH JUST THE CONCEPT/DEFINITION OF FISSION, BINARY FISSION AND MULTIPLE FISSION WITH AT LEAST TWO EXAMPLES. NO NEED TO GO IN DETAIL. 4. TEACH JUST THE CONCEPT OF BUDDING WITH AT LEAST TWO EXAMPLES. NO NEED TO GO IN DETAIL. 5. Advantageous and disadvantageous of asexual reproduction. 6. Principles of producing crops by vegetative propagation 7. Animal cloning 8. Cell cloning 9. Stem cell cloning 10. Organism cloning 11. Reproduction and non-reproductive cloning	The concepts are generic, content laden, and repetition of the tenets spelled out in other topics of the chapter
14	Chapter 14: Inheritance	345	5%	1. JUST TEACH THE CONTRIBUTION OF MENDEL AND THE SOLE REASON THAT ATTRIBUTES HIM AS THE FATHER OF GENETICS. NO	

				NEED TO TEACH WHY MENDEL'S WORK HAS REMAINED UNNOTICED FOR MANY YEARS. 2. Rediscovery of Mendel's work 3. Mendel's assumptions 4. Reasons for Mendel' success 5. Method of working 6. Advantageous of selecting a pea plant 7. Crossing techniques 8. Selection of pure lines 9. Hybridization of pure plants 10. Self-breeding in F1 hybrids 11. Self-breeding in F2 pla	The chapter has focused a lot on Mendelism. The historical aspects of Mendel do not abet much to understand the aspects of various types of inheritance
15	Chapter 15: Gene Cloning	322	5%	1. JUST TEACH THE CONCEPT OF GENE CLONING. NO NEED LOOK INTO THE DETAILS OF 10 STEPS. 2. Various types of vectors 3. Characteristics of cloning vector 4. Cloning and expression vector 5. Vectors for cloning genes in plant and animal cells 6. Competence of host cells	The concepts are content laden, technical, and repeated across the chapter
16	Chapter 16: Genetic engineering	312	5%	1. Formation of recombinant DNA or genetically modified organisms 2. Development of transgenic organisms (using vector as vehicle for gene transfer and vectorless or direct introduction of foreign DNA 3. Some GM Plants (JUST TEACH THE EXAMPLES OF GM PLANTS GIVEN IN TABLE 16.2 IN PAGE NUMBER 440) 4. Methods of producing GM plants	The concepts are content laden, technical, and the repetition of those spelled out in chapter 15

17	Chapter 17: Origin and Diversity of Life	221	4%	1. Advantageous of using scientific names 2. Criteria for five kingdom system of classification. 3. Justification for five kingdom system 4. Shortcomings of five kingdom system	The concepts make the chapter content laden and textual
18	Chapter 18: Variations	300	4%		
19	Chapter 19: Ecosystem	300	4%	Cycles within an ecosystem (need not teach the concepts subsumed under this major topic)	The concepts are studied in other subjects like chemistry and environmental science as well. Moreover, the conceptual aspects make the chapter per see voluminous and content laden with high lexical density
20	Chapter 20: Ecology of Population	187	4%		
21	Chapter 21: Pollution	187	3%		
		7, 200 minutes	**100%**		

Total time required to complete the topics is 7, 200 minutes or 180 periods of 40 minutes each.

Class: XII **Subject: Biology**

Sl No	Chapter	Time (mins)	Weighting (%)	**Remove the following topics or chapters, or paragraphs from the instruction. However, please note that those that need to focus, change, add in, or arrange accordingly during teaching are spelled out in caps or capital letters.**	Reasons
1	Chapter 1: Cell: The Unit of Life	520	5%	1. Thickening of cell wall. 2. Molecular structure of bio-membranes 3. Membrane transport (page 21-28) For cell organelles, remove only the ones listed under the topics (**bold and straight**) and sub-topics (**bold and italicized**). **Endoplasmic reticulum** 1. The endoplasmic reticulum occurs in…(second paragraph in page number 30) 2. Ultrastructure of endoplasmic reticulum **Mitochondria** 1. Mitochondria are absent in… (second paragraph in page number 32) 2. The number of mitochondria increase… (third paragraph in page number 32) 3. The size of mitochondria also… (fourth paragraph in page number 32) 4. Typically, the mitochondria…(fifth paragraph in page number 32) 5. Elementary particles 6. Mitochondria as a semiautonomous organelle **Chloroplast**	The chapter per see appears bulky, voluminous, textual, and content laden with high lexical density. Moreover, the topics listed seems vague, generic, repeated, redundant, or incongruent with the scopes of the chapter

				1. Chloroplast vary greatly in…(second paragraph in page number 35) **The stoma or matrix** Chloroplast is autonomous because… (second paragraph in page number 36) **Golgi complex** 1. Golgi complex is found in… (second paragraph in page number 38). HOWEVER, TEACH THE MORPHOLOGICAL FORMS – I) IN LOCALIZED FORM AND II) IN DIFFUSED FORM. 2. The number and size of dictysomes… (fifth paragraph in page number 38) 3. Ultra structure of Golgi complex **Lysosomes** 1. Lysosomes are present in…(third paragraph in page number 40) 2. The number of lysosomes in a cell… (fourth paragraph in page number 41) **Ribosomes** 1. Ribosomes are oblate and spheroid… (fourth paragraph in page number 44) 2. Ribosomes are particularly numerous… (fifth paragraph in page number 44) 3. The eukaryotic ribosomal RNA occurs… (eleventh paragraph in page number 45) **Centrioles**	

				1. Ultrastructure **Cilia and flagella** 1. Structure of cilia and flagella 2. Movement of cilia and flagella	
2	Chapter 2: Aggregation of cells	432	4%	1. Importance of cooperation between cells, tissues, organs, and organ system 2. Functions of parenchyma 3. Functions of epidermal tissue system (Characteristics of epithelial tissues that start from **a** to **j** (page 86-87) 4. Functions of epithelium 5. Cells of connective tissues Matrix or intercellular matrix or ground substance of connective tissue 6. Fibres of connective tissue 7. Blood 8. Blood plasma 9. Blood corpuscles: erythrocytes, functions of hemoglobin, leucocytes, and blood platelets 10. Lymph 11. Functions of muscle tissue	The chapter per see appears bulky, voluminous, textual, and content laden with high lexical density. Moreover, the topics listed seems vague, generic, repeated, redundant, or incongruent to the scope of the chapter. Moreover, the concepts appear more or less repeated across the topics within the chapter as well as the repetition of those spelled out in class 11 biology.
3	Chapter 3: Support and Movement Systems	420	6%	1. Types of muscles: Voluntary, Involuntary, and cardiac muscles	Repetition of the points spelled out in muscle tissue
4	Chapter 4: Human Digestive System	422	6%		
5	Chapter 5: Energy Systems	450	6%	1. ATP -Adenosine triphosphate	

				2. Anaerobic respiration or fermentation -given in page number 185 (Just a mechanistic explanation of those given in page number 174 and 175) 3. Mechanism-given in page number 186. 4. Energy yield 5. Importance of anaerobic respiration	Repetition of class 11 biology and the topics within the chapter
6	Chapter 6: Nervous Coordination	398	5%	1. Neurone 2. Sensitivity and Visual Acuity	Repetition of those spelled out in chapter 2 regarding the nervous tissue and appears incongruent with the scopes of the chapter
7	Chapter 7: Excretion	412	7%		
8	Chapter 8: Systems in Plants: Roots, Stems, and Leaves	350	6%	1. Structure of stomata 2. Mechanisms of stomata opening and closing 3. Factors affecting the opening and closing of stomata 4. Chloroplast	Repetition of class 11 biology and those spelled out in the first chapter
9	Chapter 9: Energy Systems in Plants: Photosynthesis	489	7%	1. The electron transport system 2. PHOTOLYSIS OF WATER (SPLITTING OF WATER BY LIGHT ENERGY) SHOULD BE TAUGHT ALONG WITH THE NON-CYCLIC PHOTOPHOSPHORYLATION AS THE SOURCE OF ELECTRON TO THE POSITIVELY CHARGED PSII. 3. Chemiosmotic hypothesis: Mechanism of ATP synthesis	Repetition of the points spelled out in photosynthetic electron transport and formation of assimilatory energy-ATP and noncyclic photophosphorylation
10	Chapter 10: Genetic Material,	489	6%	1. DNA as a genetic material	

	Genetic Code, and Protien Synthesis			2. Experimental proof for semiconservative replication of DNA 3. RNA-Ribonucleic acid 4. Molecular structure of RNA 5. Types of ribonucleic acids (mRNA, tRNA, and rRNA) 6. Functions of RNA 7. Gene mutations or point mutations-micromutations	Repetition of class 11 biology and appears beyond the scope of the chapter
11	Chapter 11: Sexual Reproduction: Meiosis	279	5%		
12	Chapter 12: Sexual Reproduction in Humans	375	6%	1. Hormonal control of cyclic changes in ovaries and uterus during menstrual cycle	Repetition of class 11 biology
13	Chapter 13: Sexual Reproduction in Flowering Plants	375	6%		
14	Chapter 14: Recombinant DNA Technology and Genetic Manipulaiton	364	5%	1. Recombinant DNA Technique from page number 403 till Hybridoma and monoclonal antibodies in page number 411	Repetition of class 11 biology
15	Chapter 15: Origin and Diversity of Life	395	5%	1. Concepts of species	Beyond the scope of the chapter
16	Chapter 16: Evolution	400	6%	1. CHANGE THE TITLE FROM MECHANISMS OF EVOLUTION TO THEORIES OF EVOLUTION	

				2. ADD MUTATION THEORY AFTER DARWINISM (Mutation theory is one of the most important theories) 3. MAKE MODERN SYNTHETIC THEORY OF EVOLUTION/NEO-DARWINISM AS ONE of THE THEORIES AND PLACE IT AFTER MUTATION THEORY (do not make modern synthetic theory of evolution as the overall topic of Mendelian population and Hardy-Weinberg principles as it is not the case in reality) 4. THE MUTATION THEORY MUST CONTAIN THE FOLLOWING ASPECTS: ✓ Evolutionists and their corresponding nomenclature for mutation ✓ Salient features of mutation theory ✓ Evidences to support mutation theory ✓ Objections against mutation theory 5. THE MODERN SYNTHETIC THEORY OF EVOLUTION MUST CONTAIN THE FOLLOWING ASPECTS (the concepts spelled out in the textbook are vague and incorrect): ✓ Evolutionists involved in the development of the theory ✓ Origin of the theory (reconciliation of Darwinism and mutation theory) ✓ Central ideas involved in the theory (stress that genetic variations and natural selection as the main forces of evolution) ✓ Causes/factors responsible for variation	The concepts spelled out are incoherent, incorrect, and incomplete

				6. REGARDING THE FACTORS AFFECTING THE GENE EQUILIBRIUM IN A POPULATION, PLEASE FOLLOW THE FOLLOWING: ✓ From the topic **genetic variations** and the sub-topic **mutation**, exclude **gene mutations** or **point mutations and chromosomal mutations** from teaching (repetition of class 11 and the details spelled out in chapter 10)	The concepts are just the repetition of those spelled out in the preceding chapter and class 11 biology
17	Chapter 17: Biodiversity and conservation	341	4%	1. Ecological or biotic succession (beyond the scope of the chapter)	
18	Chapter 18: Sustainable Management of Natural Resources	289	5%		
		7, 200 minutes	**100%**		

Total time required to complete the topics is 7, 200 minutes or 180 periods of 40 minutes each.