GENERAL BIOLOGY THEORY/PRACTICAL II

SPECIFIC CONTEXT ISSUES

In this course, student-teachers should be provided opportunities to engage in full and partial inquiries. Students begin with a question, design an investigation, gather evidence, formulate an answer to the original question, re- design an investigation until a satisfactory answer is reached.

The approach should lead to the appreciation of form and function as complementary aspects of organisms. The form or shape of any object is frequently related to use, operation or function; in other words, function frequently relies on form. Understanding of form and function applies to different levels of organization. Each organism has different structures that serve different functions in growth, survival and reproduction. The behavior of individual organisms is influenced by internal cues such as hunger and by external cues such as change in the environment. In a multicellular organism like human, specialized cells perform functions. Groups of specialized cells co-operate to form a tissue such as a muscle. Different tissues are in turn grouped together to form a larger functional unit called organ. Each type of cell, tissue and organ has a distinct structure and set of functions that serve the organism as a whole. The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control and coordination. All organisms must be able to obtain and use resources, grow, reproduce and maintain stable internal conditions while living in a constantly changing external environment. Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required. The tutor should be able to employ various methodologies to help student-teacher get to basic understanding of all the above interwoven concepts

Course Title	General Biology Theory/Practical II					
Course Code	EBS 212		Course Level: 200		Semester 2	Credit Value 3
Pre-requisites						
Course Delivery Modes	Lecturette	Case Study	Field Work	Seminar	Practical Activity	Inquiry
Course Description for significant learning	At this stage in the professional development of the student-teacher, they continue to build understanding of biological concepts through direct experience with living things. These experiences emerge from the sense of wonder and natural interests of student-teachers. Amazement about the living world should interest them to understand how individual organisms maintain and continue life. The experiences and activities at this level					

	provide a concrete foundation for the progressive development in the later levels of major biological concepts such as evolution, heredity, biosphere, interdependence and matter and energy in living systems. This course specifically covers the following topical areas: skeletal and tissue supporting systems in animals and plants, respiration in plants and animals, transport systems in plants and animals, excretory systems in plants and animals, homeostasis, hormonal and nervous co-ordination. At the background, the course continues to emphasize the essential attitudes and values of professional science teaching as creativity, critical thinking, problem solving, honesty, accuracy and precision. NTECF, NTS 2c, p.14, 3d, 3f, p15, 22	
Course Learning Outcomes	CLO 1: Describe the supporting system in plants	1.1 Enumerate the features of the supporting tissues of plants 1.2 Explain how the tissues help in supporting the rigidity and stability of plants
	CLO 2:Describe the supporting system in animals NTECF, NTS 3d, 3f, p 14, 15	1.1 Able to distinguish between animals with exoskeleton and endoskeleton 1.2 Count the number of bones in various parts of the body 1.3 Assemble pieces of bones together to a skeletal framework1.1 Able to distinguish between animals with exoskeleton and endoskeleton 1.2 Count the number of bones in various parts of the body 1.3 Assemble pieces of bones together to a skeletal
	CLO 3: Explain the transport system in plants NTECF, NTS 2c, p 14, 3j, p15	3.1 Explain the transport system in plants as a composite tissue 3.2 List misconceptions of transport in plants 3.3 Demonstrate transport of coloured water in xylem vessels

		3.4 Demonstrate exudates of cut portions on a tree on campus
	CLO 3: Demonstrate an understanding of the transport system in a small mammal NTECF, NTS 3i, 3j, p.15	3.1 Identify the major blood vessels of a dissected mammal 3.2 Work out the dangers of bleeding 3.3 Tabulate the differences among the blood vessels
	CLO 4: Describe the excretory system in plants and animals NTECF, NTS 3d, 3j p, 15	4.1 Prove that plants excrete waste materials 4.2 identify excretory organs of parts of plants under the microscope
	CLO 5: Outline the mechanism of homeostasis NTECF, NTS 2c, 3i, 3k, p15	5.1 Recall experience of illness to illustrate the disturbance of stability in the system 5.2 Measure the normal temperature of the human body
	CLO 6: Explain hormonal regulation in maintaining the normal function of the mammal NTECF, NTS 2c, 3d, 3k, p14	6.1 Identify the location of endocrine glands in the body 6.2 Outline the mechanism of synchronization of the female reproductive processes by the operation of the activities of hormones
	CLO 7: Explain the nervous system in co-ordination and control NTECF, NTS 2a, 3b 3c p15.	7.1 Prepare a concept map that illustrates the connection between the brain and neurons 7.2 Produce a chart showing how neurons work

	Units	Topics:	Sub-topics (if any):	Teaching and learning activities to achieve learning outcomes:

Course Content: Structure and life processes of organisms	1	Supporting systems in animals	Types of skeleton: exoskeleton and endoskeleton Skeletal materials (cartilage and bone) in mammals Axial and appendicular skeleton Functions of skeleton in protection, support, locomotion and respiratory movement	Identify the location and arrangement of the skeletal system in the bodies of members in the class By inspection, point out the morphological differences between bone and cartilage Concept map to outline the classification of the mammalian skeletal system Illustration of the relationship of skeleton and muscles during movement
	2	Supporting systems in plants	Different types of supporting tissues in plants Main features of supporting tissues in plants	Mention of parenchyma, collenchyma and sclerenchyma Observation of sections under the microscope

			Functions of supporting tissues in plants: strength, rigidity, resistance against the forces of wind and water, flexibility and resilience	Observation of different parts of the plant to arrive at tissues predominating in various parts for their particular functions
	3	Transport systems in plants and animals	The need for transport system. Composition and function of lymph Materials for transportation: excretory products, gases, digested food etc Structure of the heart, arteries, veins and capillaries	Discussion of surface area to volume ratio in relation to the need for transmission of gases The connection between lymph and general circulation may be illustrated by dissection of any terrestrial vertebrate Realization that the fluid blood is not flowing for its own sake but as it moves around, substances are being collected and distributed to all parts of the body Familiarization of the names of blood vessels responsible for transporting excretory products, gases, digested food and other substances

			Structure of the vascular bundles in relation to transport in plants.	Xylem and phloem should be presented as composite tissue
	4	Respiration in animals	Respiratory surfaces: cutaneous, gills, lungs Mechanism of gaseous exchange in fish, toad, mammals and plants	Brainstorming to elucidate misconceptions about respiration Simulation and video presentations on respiratory processes
	5	Excretory systems and mechanisms	Types of excretory systems in animals Kidney structure and function Excretory products such as urea, water, salts, uric acid Excretory systems in plants	Engage in co-operative learning to list the different structures i.e. the diversity in the form and function Familiarization of the structural and functional unit of the kidney so that unity in diversity could be appreciated Visual examination of student-teachers' own urine to guess the composition in different times of the day Group presentations to bring out the obscurity of stomata and lenticels as excretory organs

	6	Homeostasis	Homeostasis as constancy of conditions in the living system Osmo-regulation, excretion and maintenance of acid-base balance	PBL to demonstrate how disease conditions of a person shows that something has gone wrong in the body i.e. breakdown in structures and or functions of organism Discussion to link osmo-regulation and kidney function. How urine composition relates to acid-base balance of the human system.
	7	The skin and the liver as special organs of the body in relation to homeostasis skin and liver	Role of the liver in detoxifying blood. The blood vascular system of the liver Structure and functions of the skin	Discussion of results of liver failure to appreciate vital role Recall the rich nutrients of liver slice during a meal Structure of the skin under the microscope leading to therefore its many functions
	8	Nervous co-ordination	The central nervous system	Problem based teaching/project on functions of nerve cells

			Parts of the brain and their functions Structure and functions of the spinal cord Peripheral nervous system Autonomic nervous system	Examine an LS of the skull of sheep/cow from the abattoir Comparison of reflex and voluntary actions Differences between the peripheral nerves and spinal nerves Parasympathetic and sympathetic nervous system
	9	Nervous transmission	Structure and functions of the neurone Classification of neurons Transmission of impulses Types of nervous actions: reflex and voluntary actions	Observe, draw and label a neurone from a prepared slide Observe various types of neurons Experiments to illustrate reflex actions e.g. knee jerk

	10	Animal Hormones	Site of secretion, functions and effects of over secretion or under secretion.	Identify the ductless gland in situ
	11	Plant hormones	Auxins and lateral bud development	Demonstration of the effects of auxins on lateral bud development; leaf fall and initiation
	12	Sense organs	Structure and functions of the eye and ear The skin as a sense organ	Nature walk to suggest parts of the body that may help report observations, impressions, odour of the environment and so forth Examination of the skin in the microscope for appreciation of its complex nature for its numerous functions
Course Assessment (Educative assessment: of, for and as learning)		**Component 1:** Formative Assessment. Presentations and Practicals Weighting; 20% Asseses CLO 1,2,3 **Component 2:** Formative Assessment Quiz and two assignment Weighting : 20%		

		Assesses CLO 4, 5, 6 **Component 3:** Summative Assessment End of Semester Examination on all Units Weighting 60% Assesses all Learning Outcomes CLO 1-7
Required references	Ghana Education Service (2004) Integrated Science I for UTTDBE programme by distance *Course FD 114.* Accra Teacher Education Division Mader, S.S. *Biology*. New York. McGraw Hill Companies Inc Nyavor, B. & Seddoh , S. (2000) Biology for Senior Secondary Schools (2nd Edition) London Unimax Macmillan Roberts, M. B. V. (1982). Biology: A Functional Approach. (3rd Edition) Hong Kong, Thomas Nelson Ltd	

METHODS OF TEACHING SCIENCE

Context

The teaching of Science in schools is aimed at equipping students with the necessary science they need to navigate the world. To this end, science teaching should be conducted in a way that promotes interaction with the world. Generally, students learn through practical science. Science activities should be planned to be 'hands-on and minds-on'. There should be enough time to discuss the activity (why are we doing this activity in this way?) as well as the science (what can we see happening in the practical and why does it do that?). The discussions will help teachers diagnose whether their students have grasped the learning intentions, and identify and tackle any misconceptions students may have. Science teaching should be activity based and student-centered. Methods of Teaching Science will nurture teacher trainees to acquire professional skills that will enable them to promote learner-centeredness and dialogic discussion during their practice so that their students will understand clearly the scientific concepts. The core skills to be developed are complex thinking (that is, creativity, critical thinking and problem solving) and personal development. The teaching and learning of science should be done in such a way that new concepts are presented in real-life (outside the classroom) situations and experiences that are familiar to the students. The examples and student exercises should be presented in the context of their use. These should include many real, believable problem-solving situations that students can recognize as being important to their current or possible future lives. The students should be encouraged to gather and analyze their own data as they are guided in discovery of the important concepts. Therefore, teachers should create opportunities for students to gather and analyze their own data for enrichment and extension. The lessons and activities should encourage the student to apply concepts and information in useful contexts, projecting the student into imagined futures. The students are expected to participate regularly in interactive groups where sharing, communicating, and responding to the important concepts and decision making occur. The lessons, exercises, and teaching practices improve students' reading and other communication skills in addition to scientific reasoning and achievement.

Course Title	Methods of Teaching Science						
Course Code	**EBS 203**	Course Level	300	Credit value	3	Semester	2
Pre-requisite	Students have studied Senior High School Integrated Science						

Course Delivery Modes	Face-to-face ☐	Practical Activity ■	Work-Based Learning ■	Seminars ☐	Independent Study ☐	e-learning opportunities ☐	Practicum ■
Course Description for significant learning (indicate NTS, NTECF, BSC GLE to be addressed)	This course will introduce students to the nature of science and its implication for teaching and learning, and the basic knowledge and practices in the use of different methods in the teaching and learning of sience in the junior high school. Students will acquire basic knowledge and practice in the use of lesson plans to enable them become well prepared to teach science. Teaching methods such as activity method, demonstration, discussion, guided discovery, games, projects, and field trips will be discussed. It will also require student-teachers to scaffold learning; practice how to promote active engagement of the learner; expose and discuss common misconceptions; organize the syllabus into schemes of work and further into lesson notes; use assessment as a means of advancing learning; develop effective and interactive teaching techniques and styles; and use collaborative rich tasks to engage pupils in co-operative small group work. (NTS 2a, 2b, 2c,2e. 2f, p.13; 3e-3o, p.14; NTECF Pillar 1; NTECF Pillar 3)						
Course Learning Outcomes: including INDICATORS for Each learning outcome	Outcomes By the end of the course the student would be able to: CLO 1. Describe the nature of science and its implication for teaching and learning. (NTS 2c, 2e p. 13, 3h, 3j, p. 14).	Indicators The student will be able to: • explain the science as a body of knowledge, method for acquiring knowledge, and as an institution • explain the pedagogical implications to the teaching and learning process • explain why we teach science in basic schools • describe at least six characteristics of scientific knowledge • describe the processes and products of science • differentiate between science and technology					
	CLO 2. List and explain the resources for science	• State the different types of teaching support materials • Describe the importance of resources for teaching science					

	teaching (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Explain the principles for the selection of teaching aids • Explain the guidelines for effective use of teaching aids • Describe how to improvise three materials for teaching science
	CLO 3. Describe the roles of the teacher in the teaching and learning process (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Explain the concepts of teaching as a science and an art • Describe six teaching competencies • Explain the roles of the teacher in the teaching and learning process
	CLO 4. Analyze the three categories of learning (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Differentiate among the three categories of learning (cognitive learning, affective learning and psychomotor learning) • Describe the pedagogical implications each of the three categories of learning
	CLO 5. Analyze the three major theories of learning (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Differentiate among the three major theories of learning • Describe the pedagogical implications each of the three major theories of learning
	CLO 6. Formulate SMART instructional objectives (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Formulate SMART learning objectives (performance based objectives) in the three domains of learning • Evaluate learning objectives

	CLO 7. Explain the general principles of methods of teaching (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Describe the foundational belief structure of teaching and learning • Explain the Basic Principles of Curriculum and Instruction (Ralph W. Tyler) • Describe Merrill's Principles of Instruction • Explain Kolb's theory of experiential learning
	CLO 8. Describe effective classroom management (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Tell why classroom management matters • Demonstrate knowledge on how to prevent management problems by focusing students on learning • Demonstrate effective way of responding to student misbehaviour
	CLO 9. Describe assessment strategies (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Explain why we use varied tools for assessment in science • Describe six methods for collecting evidence of science learning
	CLO 10. Describe the methods for teaching Science (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Demonstrate knowledge on the methods of teaching science • Integrate the methods of teaching science during teaching practices
	CLO 11. Write lesson plans for teaching Science (NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Prepare lesson notes for teaching Science
	CLO 12. Demonstration of professional knowledge in science teaching (NTECF Pillar 3, p.28; NTS 2a, 2b, 2c,2e. 2f, p. 13; 3e-3o, p. 14)	• Group and/or individual teaching practices

Course Content	Units	Topics	Sub-topics (if any):	Teaching and learning activities to achieve learning outcomes
	1	Nature of Science	1.1 Nature of Science - Science as a body of knowledge - Science as a method for acquiring knowledge - Science as an institution 1.2 Implications to the teaching and learning process (pedagogical implications) 1.3 Why teach science in basic schools? 1.4 Characteristics of Scientific Knowledge 1.5 Process and products of Science 1.6 Products of science 1.7 Science and Technology 1.8 Relationship of science and traditional belief in the teaching of science	a. Pair students (cooperative learning) and ask them to think and share ideas on 1.1, 1.2, 1.3, 1.4 b. Using cooperative learning, put students in groups (5-6 students per group) and ask them to discuss sub-topics 1.5, 1.6, 1.7 and 1.8. c. Student presentation followed by a general class discussion
	2	Teaching	2.1 Concepts of teaching as a science and an art 2.2 Teaching competencies 2.3 Roles of the teacher in the teaching and learning process 2.4 Three main phases of teaching 2.5 Reflective teaching	a. Brainstorming to come out with the conception of teaching and teaching competencies b. Student presentation on the roles of the teacher in the teaching and learning process c. Class discussion on the three main phases of teaching and reflective teaching d. Discuss reflective teaching and reflective journals with students
	3	Learning	3.1 Deductive and inductive learning 3.2 Categories of learning (cognitive learning, affective learning and psychomotor learning)	a. Ask students to research on 3.1, 3.2, and 3.3 and present their work in class b. Class discussion

			3.3 Behavioural and cognitive views of learning, and the constructivist theories of learning 3.4 Pedagogical implications each of the three major learning theories	
	4	Instructional Objectives	4.1 Goals and objectives 4.2 Bloom's taxonomy of cognitive learning 4.3 Bloom's taxonomy of affective learning 4.4 Psychomotor domain of learning 4.5 Formulation of learning objectives (performance based objectives) in the three domains of learning 4.6 Evaluation of instructional, behavioural and learning objectives 4.7 Profile dimensions of teaching and learning at the basic school level	a. Working in groups to develop learning objectives that reflect all the domains of learning b. Individuals to develop learning objectives that target both low order and high order thinking skills c. Individual to develop learning objectives focused on affective and psychomotor domains of learning d. Self and peer assessment of developed learning objectives
	5	Teaching devices	5.1 Types of teaching aids 5.2 Importance of teaching aids 5.3 Principles for the selection of teaching aids 5.4 Guidelines for effective use of teaching aids 5.5 Computer simulation 5.6 Improvisation	a. Student presentation and class discussion
	8	Classroom Management	7.1 Management of student behaviour 7.2 Management of the learning environment	a. Students to develop rules for checking student conduct b. Watch a model science lesson and discuss the management of student behaviour and the learning environment followed by a general class discussion

	7	Assessment strategies	8.1 Assessment of student learning	a. General class discussion on the methods for collecting evidence of science learning b. Watch a video of a science lesson and discuss the assessment strategies used by the teacher
	8	Lesson Plan	9.1 Principles of teacher planning 9.2 Factors that influence teacher planning 9.3 Scheme of work 9.4 Importance of a termly scheme of work 9.5 Features and format/structure of the termly scheme of work 9.6 Guidelines for the preparation of termly scheme of work 9.7 Advantages of using a scheme of work ● Lesson plan ● Features and format/structure of the lesson plan ● Advantages of using a lesson plan	a. Visit to basic schools to observe science lesson notes b. Discussion of lesson notes prepared by basic school science teachers c. Working in groups to develop comprehensive lesson notes d. Individuals to develop lesson notes
	9	Methods of teaching chemistry	10.1General principles of methods of teaching 10.2 Teaching methods - Activity method - Discovery - Question and Answer - Demonstration - Field Trip - Laboratory Work - Brainstorming - Discussion - Project - Role Play/Dramatization	a. Visits to basic schools to observe and record science lessons b. Play the recorded lesson and discuss the teaching methods used by the teacher c. Class discussion of the various teaching methods

			- Lecture/Lecturette - Games/Simulation - Problem solving - Innovative teaching methods such as argumentation, context-based learning, computational thinking, multimedia approach, ICT enabled learning, documented problem solving, etc.	
	10	Peer teaching		a. Visit to basic schools to observe science lessons of experienced teachers b. Watch videos of exemplary teaching practices followed by a general class discussion c. Individual or group teaching practices followed by peer assessment of the practices d. Videotape individual or group teaching practices and play the video for the individual or group teacher(s) to assess their performance (self-assessment)
Course Assessment (Educative assessment: of, for and as learning)	**Component 1**: Formative assessment (quizzes, class tests, class exercises, and assignments) Summary of Assessment Method: Quizzes, class test, class exercises and assignments on Unit 1 - 7(core skills to be developed: critical thinking , creativity, and personal development) Assessment Weighting: 20% Assesses Learning Outcomes: CLO 1, 2, 3, 4, 5, 6, 7, 8 and 9(Units1 - 7) **Component 2**: Formative assessment (group and/or individual teaching) Summary of Assessment Method: Group and/or individual teachingon Unit 8, 9 and 10(core skills to be developed are effective communicative skills, collaborative skills, critical thinking skills, teaching skills). Students will be involved in assessing their colleagues (peer assessment)			

	Assessment Weighting: 20% Assesses Learning Outcomes: CLO 10, 11 and 12 (Units 8, 9 and 10) **Component 3**: Summative assessment Summary of Assessment Method: End of semester examination (composed of multiple choice questions and essay-type questions)on Units 1 to 10(core skills to be developed: critical thinking, creative thinking, problem solving, innovation, and personal development) Weighting: 60% Assesses Learning Outcomes: CLO 1-10. The grading system will be guided by the following: **A**=80-100%; **B+=**75-79%; **B** =70-74%, C+ =65-69%, **C=** 60-64%, D+ = 55-59, D = 50-54, **FAIL**<50
Instructional Resources	1. Visual aids such as marker boards 2. Audio-visual aids such as computers (with internet connectivity) and projectors, television, DVD discs and DVD player. 3. Activity aids such as visits to basic schools
Required Text (core)	Bybee, R. W., Powell, J. C., & Trowbridge, L. W. (2008). *Teaching secondary science: Strategies for developing scientific literacy.* New Jersey: Pearson Education. Bybee, R. W. (Ed.). (2002). *Learning science and the science of learning.* Arlington, VA: NSTAPress. Ghana Education Service (2004). *Integrated Science 1 for UTTDBE programme by distance. Course FDC 114.* Accra: Teacher Education Division. Gronlund, N.E. (1985). *Stating objectives for classroom instruction*. (3rd ed.). New York: Macmillan Publishing Company.

	Marzano, R. J. (2018). *The Handbook for the New Art and Science of Teaching*. Bloomington: Solution Tree Press Marzano, R. J. (2017). *The New Art and Science of Teaching: More than fifty instructional strategies for student success*. Bloomington: Solution Tree Press Marzano, R. J., Norford, J. S., & Ruyle, M. (2018). *The New Art and Science of Classroom Assessment (Authentic Assessment Methods and Tools for the Classroom)*. Bloomington: Solution Tree Press Ministry of Education (2012). *Teaching syllabus for integrated science, upper primary* Accra: CRDD. Ministry of Education (2012). *Teaching syllabus for natural science, lower primary*. Accra: CRDD Perrot, E. (1986). *Effective teaching: A practical guide to improving your teaching*. Essex: Longman Group UK Ltd. Peters, J. M. & Stout, D. S. (2010). *Science in Elementary Education: Methods, Concepts, and Inquiries (11th Edition).* Harlow: Pearson Education Limited Killen, R. (2003). *Effective Teaching Strategies: Lessons from Research and Practice* (3rded). Victoria: Thomson Social Science Press.
Additional Reading List	Yadov, N., John, M. (Ed.). (2013). *Pedagogy of science: Physical science (I & II).* New Delhi: National Council of Educational Research and Training