Biology 111-112
Curriculum

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New Nouveau Brunswick

New Brunswick Department of Education

Teaching Framework
Biology 11 and 12
(levels 1 and 2)

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Table of Contents

Introduction

Background

The curriculum described in *Foundation for the Atlantic Canada Science Curriculum* was planned and developed collaboratively by regional committees. The process for developing the common science curriculum for Atlantic Canada involved regional consultation with the stakeholders in the education system in each Atlantic province. The Atlantic Canada science curriculum is consistent with the science framework described in the pan-Canadian *Common Framework of Science Learning Outcomes K to 12.*

The development of these curricula involved further revision of the *Atlantic Canada Science Curriculum* for Biology 11 and Biology 12, in consultation with educators in New Brunswick over a 3-year period (as listed in the Acknowledgements).

Rationale

The aim of science education in the Atlantic provinces is to develop scientific literacy.

Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become life-long learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences which provide opportunity to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, their careers, and their future.

Program Design & Components

Learning and Teaching Science

What students learn is fundamentally connected to how they learn it. The aim of scientific literacy for all has created a need for new forms of classroom organization, communication, and instructional strategies. The teacher is a facilitator of learning whose major tasks include

- creating a classroom environment to support the learning and teaching of science
- designing effective learning experiences that help students achieve designated outcomes
- stimulating and managing classroom discourse in support of student learning
- learning about and then using students' motivations, interests, abilities, and learning styles to improve learning and teaching
- analyzing student learning, the scientific tasks and activities involved, and the learning environment to make ongoing instructional decisions
- selecting teaching strategies from a wide repertoire

Effective science learning and teaching take place in a variety of situations. Instructional settings and strategies should create an environment which reflects a constructive, active view of the learning process. Learning occurs not by passive absorption, but rather as students actively construct their own meaning and assimilate new information to develop new understanding.

The development of scientific literacy in students is a function of the kinds of tasks they engage in, the discourse in which they participate, and the settings in which these activities occur. Students' disposition towards science is also shaped by these factors. Consequently, the aim of developing scientific literacy requires careful attention to all of these facets of curriculum.

Learning experiences in science education should vary and include opportunities for group and individual work, discussion among students as well as between teacher and students, and hands-on/minds-on activities that allow students to construct and evaluate explanations for the phenomena under investigation. Such investigations and the evaluation of the evidence accumulated, provide opportunities for students to develop their understanding of the nature of science and the nature and status of scientific knowledge.

The Three Processes of Scientific Literacy

An individual can be considered scientifically literate when he/she is familiar with, and able to engage in, three processes: inquiry, problem solving, and decision making.

Inquiry

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement that there is no such thing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analyzing data, and interpreting data are fundamental to engaging in science. These activities provide students opportunity to understand and practice the process of theory development in science and the nature of science.

Problem Solving

The process of problem solving involves seeking solutions to human problems. It consists of the proposing, creating, and testing of prototypes, products and techniques in an attempt to reach an optimum solution to a given problem.

Decision Making

The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are not only important in their own right. They also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Meeting the Needs of All Learners

Foundation for the Atlantic Canada Science Curriculum stresses the need to design and implement a science curriculum that provides equal opportunities for all students according to their abilities, needs and interests. Teachers must be aware of and make adaptations to accommodate the diverse range of learners in their class. In order to adapt to the needs of all learners, teachers must create opportunities that would permit students to have their learning styles addressed.

As well, teachers must not only remain aware of and avoid gender and cultural biases in their teaching, they must strive to actively address cultural and gender stereotyping regarding interest and success in science and mathematics. Research supports the position that when science curriculum is made personally meaningful, and socially and culturally relevant, it is more engaging for groups traditionally under-represented in science, and indeed, for all students.

When making instructional decisions, teachers must consider

individuals' learning needs, preferences and strengths, and the abilities, experiences, interests, and values that learners bring to the classroom. Ideally, every student should find his/her learning opportunities maximized in the science classroom.

While this curriculum guide presents specific outcomes for each unit, it must be acknowledged that students will progress at different rates. Teachers should provide materials and strategies that accommodate student diversity, and validate students when they achieve the outcomes to the maximum of their abilities.

It is important that teachers articulate high expectations for all students and ensure that all students have equitable opportunities to experience success as they work toward the achievement of designated outcomes. A teacher should adapt classroom organization, teaching strategies, assessment practices, time, and learning resources to address students' needs and build on their strengths. The variety of learning experiences described in this guide provides access for a wide range of learners. Similarly, the suggestions for a variety of assessment practices provide multiple ways for learners to demonstrate their achievements.

Assessment and Evaluation

The terms assessment and evaluation are often used interchangeably, but they refer to quite different processes. Science curriculum documents developed in the Atlantic region use these terms for the processes described below.

Assessment is the systematic process of gathering information on student learning.

Evaluation is the process of analyzing, reflecting upon, and summarizing assessment information, and making judgments or decisions based upon the information gathered.

The assessment process provides the data and the evaluation process brings meaning to the data. Together, these processes improve teaching and learning. If we are to encourage enjoyment in learning for students, now and throughout their lives, we must develop strategies to involve students in assessment and evaluation at all levels. When students are aware of the outcomes for which they are responsible, and the criteria by which their work will be assessed or evaluated, they can make informed decisions about the most effective ways to demonstrate their learning.

Regional curriculum in science suggests experiences that support learning within STSE, skills, knowledge and attitudes. It also reflects the three major processes of science learning: inquiry, problem solving and decision making. When assessing student progress it is helpful to know some activities/skills/actions that are associated with each process of science learning. Examples of these are illustrated in the following lists. Student learning may be described in terms of ability to perform these tasks.

Inquiry

- define questions related to a topic
- refine descriptors/factors that focus practical and theoretical research
- select an appropriate way to find information
- make direct observations
- perform experiments, record and interpret data, and draw conclusions
- design an experiment which tests relationships and variables
- write lab reports that meet a variety of needs (limit the production of "formal" reports) and place emphasis on recorded data
- recognize that both quality of both the process and the product are important

Problem Solving

- clearly define a problem
- produce a range of potential solutions for the problem
- appreciate that several solutions should be considered
- plan and design a product or device intended to solve a problem
- construct a variety of acceptable prototypes, pilot test, evaluate and refine to meet a need
- present the refined process/product/device and support why it is "preferred"
- recognize that both quality of both the process and the product are important

Decision Making

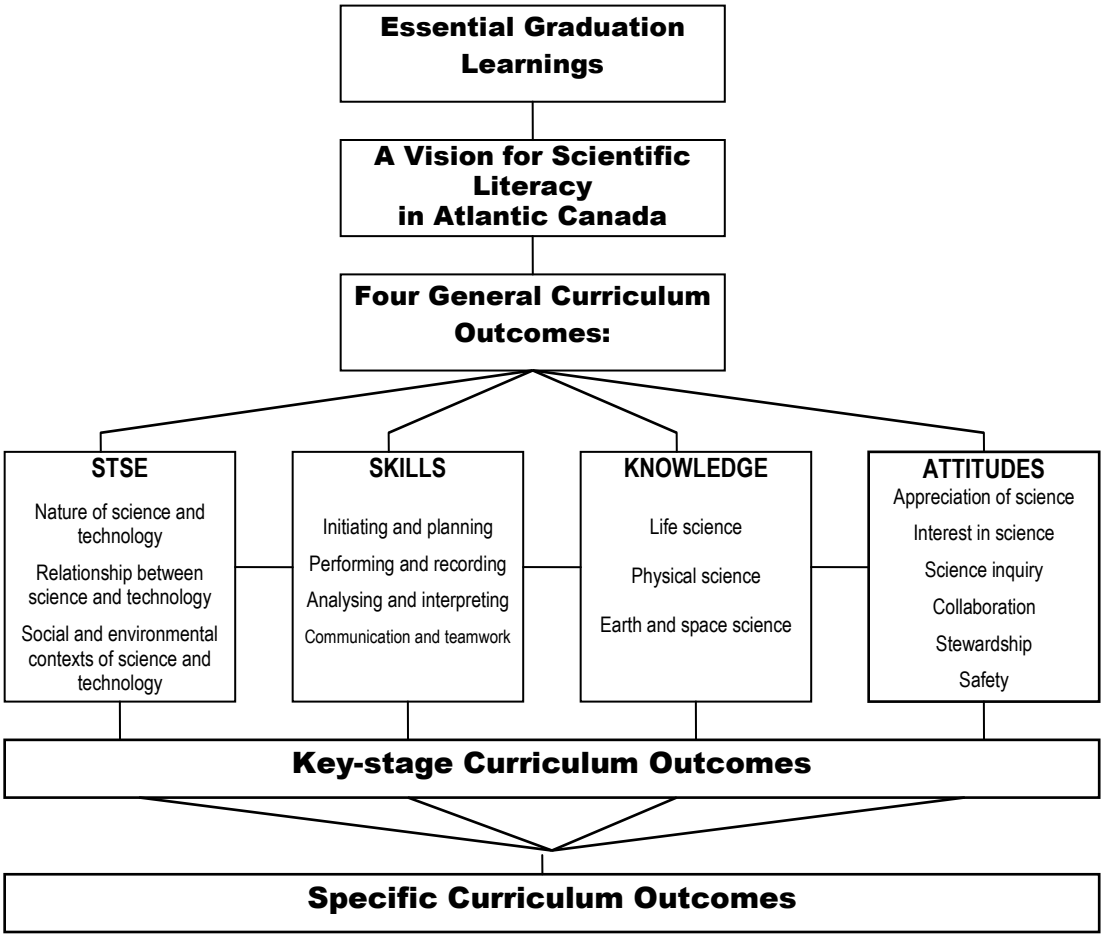
- gather information from a variety of sources
- evaluate the validity of the information source
- evaluate which information is relevant
- identify the different perspectives that influence a decision
- present information in a balanced manner
- use information to support a given perspective
- recommend a decision and provide supporting evidence
- communicate a decision and provide a "best" solution

Outcomes

Outcomes Framework

The science curriculum is based on an outcomes framework that includes statements of essential graduation learnings, general curriculum outcomes, key-stage curriculum outcomes, and specific curriculum outcomes. The general, key-stage, and specific curriculum outcomes reflect the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. The conceptual map shown in Figure 1 provides the blueprint of the outcomes framework.

FIGURE 1



This curriculum guide outlines grade level specific curriculum outcomes, and provides suggestions for learning, teaching, assessment and resources to support students' achievement of these outcomes. Teachers should consult the *Foundation for the Atlantic Canada Science Curriculum* for descriptions of the essential graduation learnings, vision for scientific literacy, general curriculum outcomes, and key-stage curriculum outcomes.

Curriculum Guide Organization

Specific curriculum outcome statements describe what students should know and be able to do at each grade level. They are intended to serve as the focus for the design of learning experiences and assessment tasks. Specific curriculum outcomes represent a reasonable framework for assisting students to achieve the key-stage, the general curriculum outcomes, and ultimately the essential graduation learnings.

Specific curriculum outcomes are organized in three units for each grade level. Each unit is organized by topic. Suggestions for learning, teaching, assessment, and resources are provided to support student achievement of the outcomes.

The order in which the three units of a grade appear in the guide is meant to suggest a sequence. In some cases the rationale for the recommended sequence is related to the conceptual flow across the year. That is, one unit may introduce a concept which is then extended in a subsequent unit. Likewise, it is possible that one unit focuses on a skill or context which will then be built upon later in the year. In some cases the rationale is related to weather and the necessity of dealing with Life or Earth science units in the fall or spring.

It is also possible that units or certain aspects of units can be combined or integrated. This is one way of assisting students as they attempt to make connections across topics in science or between science and the real world.

Extended time frames may be needed to collect data over time on such things as weather patterns or plant growth. These cases may warrant starting the activity prior to the unit in which it will be used. In all cases logical situations and contexts should be taken into consideration when these types of decisions are made.

The intent is to provide opportunities for students to deal with science concepts and scientific issues in personally meaningful, and socially and culturally, relevant contexts.

Unit Organization

All units comprise a two-page layout of four columns as illustrated in Figure 2. Each unit is comprised of outcomes grouped by a topic which is indicated at the top of the left page.

Column One:
Essential Learning Outcomes

The first column lists a group of ***NB prescribed outcomes*** that relate to the pan-Canadian *Specific Curriculum Outcomes* listed at the beginning of each unit. These are based on the pan-Canadian *Common Framework of Science Learning Outcomes K to 12.* This column also includes appropriate extensions for those students enrolled in ***Biology 111*** or ***Biology 121***. The statements involve the Science-Technology-Society-Environment (STSE), skills, and knowledge outcomes indicated by the outcome number(s) that appears in brackets after the outcome statement.

Curriculum outcomes for each unit have been grouped by topic. Other groupings of outcomes are possible and in some cases may be necessary in order to take advantage of local situations. The grouping of outcomes

provides a suggested teaching sequence. Teachers may prefer to plan their own teaching sequence to meet the learning needs of their students.

Column Two: Elaborations

The second column includes **Elaborations** of the outcomes, as well as background information. Also included are **Teaching Suggestions**, and ***Optional*** extensions of the topic. The suggestions in this column are intended to provide a holistic approach to instruction. In some cases, the suggestions in this column address a single outcome; in other cases, they address a group of outcomes.

Column Three: Tasks for Instruction and/or Assessment

The third column provides suggestions for ways that students' achievement of the outcomes could be taught and assessed. These suggestions reflect a variety of assessment techniques which include, but are not limited to, informal/formal observation, performance, journals, interview, paper and pencil, presentations, and portfolio. Some assessment tasks may be used to assess student learning in relation to a single outcome, others to assess student learning in relation to several outcomes. The assessment item identifies the outcome(s) addressed by the outcome number in brackets after the item.

Column Four: Notes

This column will refer teachers to the supporting text and other resources. For current useful websites, and shared teacher resources, teachers are directed to the NB government Teacher Portal at: https://portal.nbed.nb.ca/

FIGURE 2
Curriculum Outcomes Organization: The Four-Column, Two-Page Spread

Topic			
NB Prescribed Outcomes	*Elaborations*	*Tasks for Instruction and/or Assessment*	*Notes*
• Outcomes based on Pan-Canadian Specific Learning Outcomes • Additional outcomes for Level 1 course • Optional outcomes to be completed after completion of above outcomes	Elaborations of outcomes listed in column one Teaching Suggestions	Informal/Formal Observation Performance Journal Interview Paper and Pencil Presentation Portfolio	References to prescribed text and supporting resources. References to Appendices.

Unit Overview

At the beginning of each unit, there is a two-page synopsis. On the first page, introductory paragraphs give a unit overview. These are followed by a section that specifies the focus (inquiry, problem solving, and/or decision making) and possible contexts for the unit. Finally, a curriculum links paragraph specifies how this unit relates to science concepts and skills that will be addressed at later grades so teachers will understand how the unit fits with the students' progress through the complete science program.

The second page of the two-page overview provides a table of the outcomes from the *Common Framework of Science Learning Outcomes K to 12* that will be addressed in the unit. The numbering system used is the one followed in the pan-Canadian document:

100s - Science-Technology-Society-Environment (STSE) outcomes

200s - Skills outcomes

300s - Knowledge outcomes

400s- Attitude outcomes (see pages 10-18)

These code numbers appear in brackets after each specific curriculum outcome (SCO).

FIGURE 3
Unit Overview

Unit Title: Unit Overview		**Unit Title: Pan Canadian Specific Curriculum Outcomes**		
		STSE	**Skills**	**Knowledge**
Introduction	Synopsis of the unit	###Science-Technology-Society-Environment outcomes from *Common Framework of Science Learning Outcomes K to 12*	###Skills outcomes from *Common Framework of Science Learning Outcomes K to 12*	###Knowledge outcomes from *Common Framework of Science Learning Outcomes K to 12*
Focus and Contexts	Focus: Inquiry, Decision Making, or Problem Solving. Possible contexts suggested			
Curriculum Links	Links to concepts studied within the K-12 science curriculum			

Attitude Outcomes

It is expected that certain attitudes will be fostered and developed throughout the entire science program, entry to grade 12. The STSE, skills and knowledge outcomes contribute to the development of attitudes, and opportunities for fostering these attitudes are highlighted in the *Suggestions for Learning and Teaching* section of each unit.

Attitudes refer to generalized aspects of behaviour that are modeled for students by example and reinforced by selective approval. Attitudes are not acquired in the same was as skills and knowledge. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what they learn.

Since attitudes are not acquired in the same way as skills and knowledge, outcomes statements for attitudes are written for the end of grades 3, 6, 9 and 12. These outcomes statements are meant to guide teachers in creating a learning environment that fosters positive attitudes.

The following pages present the attitude outcomes from the pan-Canadian *Common Framework of Science Learning Outcomes K to 12.*

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From entry through grade 3 it is expected that students will be encouraged to…

Appreciation of science	**Interest in science**	**Scientific inquiry**
400 recognize the role and contribution of science in their understanding of the world ***Evident when students, for example,*** – give examples of science in their own lives – give examples of how objects studied and investigations done in class relate to the outside world – recognize that scientific ideas help us to explain how or why events occur	401 show interest in and curiosity about objects and events within the immediate environment 402 willingly observe, question, and explore ***Evident when students, for example,*** – ask "why" and "how" questions about observable events – ask many questions related to what is being studied – participate in show-and-tell activities, bringing objects from home or sharing a story or an observation – ask questions about what scientists do – express enjoyment from being read to from science books – seek out additional information from library books and digital discs – express enjoyment in sharing science-related information gathered from a variety of sources, including discussions with family members and friends – ask to use additional science equipment to observe objects in more detail – express the desire to find answers by exploring and conducting simple experiments	403 consider their observations and their own ideas when drawing a conclusion 404 appreciate the importance of accuracy 405 be open-minded in their explorations ***Evident when students, for example,*** – raise questions about the world around them – willingly record observations in a given format – compare results of an experiment with other classmates – use observations to draw a conclusion or verify a prediction – take the time to measure with care – willingly explore a change and its effects – choose to follow directions when they complete a simple investigation – express the desire to find answers by conducting simple experiments

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From entry through grade 3 It is expected that students will be encouraged to…

Collaboration	**Stewardship**	**Safety**
406 work with others in exploring and investigating ***Evident when students, for example***, – willingly share ideas and materials – respond positively to others' questions and ideas – take on and fulfil a variety of roles within the group – participate in science-related activities with others, regardless of their age or their physical or cultural characteristics – respond positively to other people's views of the world	407 be sensitive to the needs of other people, other living things, and the local environment ***Evident when students, for example,*** – ensure that living things are returned to an adequate environment after a study is completed – demonstrate awareness of the need for recycling and willingness to take action in this regard – show concern for other students' feelings or needs – care for living things that are kept in their classroom – clean reusable materials and store them in a safe place – willingly suggest how we can protect the environment	408 show concern for their safety and that of others in carrying out activities and using materials ***Evident when students, for example***, – are attentive to the safe use of materials – insist that classmates use materials safely – act with caution in touching or smelling unfamiliar materials, refrain from tasting them, and encourage others to be cautious – point out to others simple and familiar safety symbols – put materials back where they belong – follow given directions for set-up, use, and clean-up of materials – wash hands before and after using materials, as directed by teacher – seek assistance immediately for any first aid concerns like cuts, burns, and unusual reactions – keep the work station uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From grades 4-6 It is expected that students will be encouraged to…

Appreciation of science	Interest in science	Scientific inquiry
409 appreciate the role and contribution of science and technology in their understanding of the world 410 realize that the applications of science and technology can have both intended and unintended effects 411 recognize that women and men of any cultural background can contribute equally to science ***Evident when students, for example,*** – recognize that scientific ideas help explain how and why things happen – recognize that science cannot answer all questions – use science inquiry and problem-solving strategies when given a question to answer or a problem to solve – plan their actions to take into account or limit possible negative and unintended effects – are sensitive to the impact their behaviour has on others and the environment when taking part in activities – show respect for people working in science, regardless of their gender, their physical and cultural characteristics, or their views of the world – encourage their peers to pursue science-related activities and interests	412 show interest and curiosity about objects and events within different environments 413 willingly observe, question, explore, and investigate 414 show interest in the activities of individuals working in scientific and technological fields ***Evident when students, for example,*** – attempt to answer their own questions through trial and careful observation – express enjoyment in sharing and discussing with classmates science-related information – ask questions about what scientists in specific fields do – express enjoyment in reading science books and magazines – willingly express their personal way of viewing the world – demonstrate confidence in their ability to do science – pursue a science-related hobby – involve themselves as amateur scientists in exploration and scientific inquiry, arriving at their own conclusions rather than those of others	415 consider their own observations and ideas as well as those of others during investigations and before drawing conclusions 416 appreciate the importance of accuracy and honesty 417 demonstrate perseverance and a desire to understand ***Evident when students, for example***, –ask questions to clarify their understanding – respond constructively to the questions posed by other students – listen attentively to the ideas of other students and consider trying out suggestions other than their own – listen to, recognize, and consider differing opinions – open-mindedly consider non-traditional approaches to science – seek additional information before making a decision – base conclusions on evidence rather than preconceived ideas or hunches – report and record what is observed, not what they think ought to be or what they believe the teacher expects – willingly consider changing actions and opinions when presented with new information or evidence – record accurately what they have seen or measured when collecting evidence – take the time to repeat a measurement or observation for confirmation or greater precision – ask questions about what would happen in an experiment if one variable were changed – complete tasks undertaken or all steps of an investigation

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From grades 4-6 It is expected that students will be encouraged to…

Collaboration	**Stewardship**	**Safety**
418 work collaboratively while exploring and investigating ***Evident when students, for example,*** – participate in and complete group activities or projects – willingly participate in cooperative problem solving – stay with members of the group during the entire work period – willingly contribute to the group activity or project – willingly work with others, regardless of their age, their gender or their physical or cultural characteristics – willingly consider other people's views of the world	419 be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment ***Evident when students, for example,*** – choose to have a positive effect on other people and the world around them – frequently and thoughtfully review the effects and consequences of their actions – demonstrate willingness to change behaviour to protect the environment – respect alternative views of the world – consider cause and effect relationships that exist in environmental issues – recognize that responding to their wants and needs may negatively affect the environment – choose to contribute to the sustainability of their community through individual positive actions – look beyond the immediate effects of an activity and identify its effects on others and the environment	420 show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials 421 become aware of potential dangers ***Evident when students, for example,*** – look for labels on materials and seek help in interpreting them – ensure that all steps of a procedure or all instructions given are followed – repeatedly use safe techniques when transporting materials – seek counsel of the teacher before disposing of any materials – willingly wear proper safety attire, when necessary – recognize their responsibility for problems caused by inadequate attention to safety procedures – stay within their own work area during an activity, to minimize distractions and accidents – immediately advise the teacher of spills, breaks, or unusual occurrences – share in cleaning duties after an activity – seek assistance immediately for any first aid concerns like cuts, burns, and unusual reactions – keep the work station uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

For grades 7-9 It is expected that students will be encouraged to…

Appreciation of science	Interest in science	Scientific inquiry
422 appreciate the role and contribution of science and technology in our understanding of the world 423 appreciate that the applications of science and technology can have advantages and disadvantages 424 appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds ***Evident when students, for example,*** – recognize the potential conflicts of differing points of view on specific science-related issues – consider more than one factor or perspective when formulating conclusions, solving problems, or making decisions on STSE issues – recognize the usefulness of mathematical and problem-solving skills in the development of a new technology – recognize the importance of drawing a parallel between social progress and the contributions of science and technology – establish the relevance of the development of information technologies and science to human needs – recognize that science cannot answer all questions – consider scientific and technological perspectives on an issue – identify advantages and disadvantages of technology – seek information from a variety of disciplines in their study – avoid stereotyping scientists – show an interest in the contributions women and men from many cultural backgrounds have made to the development of science and technology	425 show a continuing curiosity and interest in a broad scope of science-related fields and issues 426 confidently pursue further investigations and readings 427 consider many career possibilities in science- and technology-related fields ***Evident when students, for example,*** – attempt at home to repeat or extend a science activity done at school – actively participate in co-curricular and extra-curricular activities such as science fairs, science clubs, or science and technology challenges – choose to study topics that draw on research from different science and technology fields – pursue a science-related hobby – discuss with others the information presented in a science show or on the Internet – attempt to obtain information from a variety of sources – express a degree of satisfaction at understanding science concepts or resources that are challenging – express interest in conducting science investigations of their own design – choose to investigate situations or topics that they find challenging – express interest in science- and technology-related careers – discuss the benefits of science and technology studies	428 consider observations and ideas from a variety of sources during investigations and before drawing conclusions 429 value accuracy, precision, and honesty 430 persist in seeking answers to difficult questions and solutions to difficult problems ***Evident when students, for example,*** – ask questions to clarify meaning or confirm their understanding – strive to assess a problem or situation accurately by careful analysis of evidence gathered – propose options and compare them before making decisions or taking action – honestly evaluate a complete set of data based on direct observation – critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion – critically consider ideas and perceptions, recognizing that the obvious is not always right – honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results – take the time to gather evidence accurately and use instruments carefully – willingly repeat measurements or observations to increase the precision of evidence – choose to consider a situation from different perspectives – identify biased or inaccurate interpretations – report the limitations of their designs – respond skeptically to a proposal until evidence is offered to support it – seek a second opinion before making a decision – continue working on a problem or research project until the best possible solutions or answers are identified

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From grades 7-9 It is expected that students will be encouraged to…

Collaboration	Stewardship	Safety in science
431 work collaboratively in carrying out investigations as well as in generating and evaluating ideas ***Evident when students, for example,*** – assume responsibility for their share of the work to be done – willingly work with new individuals regardless of their age, their gender, or their physical or cultural characteristics – accept various roles within a group, including that of leadership – help motivate others – consider alternative ideas and interpretations suggested by members of the group – listen to the points of view of others – recognize that others have a right to their points of view – choose a variety of strategies, such as active listening, paraphrasing, and questioning, in order to understand others' points of view – seek consensus before making decisions – advocate the peaceful resolution of disagreements – can disagree with others and still work in a collaborative manner – are interested and involved in decision making that requires full-group participation – share the responsibility for carrying out decisions – share the responsibility for difficulties encountered during an activity	432 be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment 433 project, beyond the personal, consequences of proposed actions ***Evident when students, for example,*** – show respect for all forms of life – consider both the immediate and long-term effects of their actions – assume personal responsibility for their impact on the environment – modify their behaviour in light of an issue related to conservation and protection of the environment – consider the cause-and-effect relationships of personal actions and decisions – objectively identify potential conflicts between responding to human wants and needs and protecting the environment – consider the points of view of others on a science-related environmental issue – consider the needs of other peoples and the precariousness of the environment when making decisions and taking action – insist that issues be discussed using a bias-balanced approach – participate in school or community projects that address STSE issues	434 show concern for safety in planning, carrying out, and reviewing activities 435 become aware of the consequences of their actions ***Evident when students, for example,*** – read the labels on materials before using them, and ask for help if safety symbols are not clear or understood – readily alter a procedure to ensure the safety of members of the group – select safe methods and tools for collecting evidence and solving problems – listen attentively to and follow safety procedures explained by the teacher or other leader – carefully manipulate materials, using skills learned in class or elsewhere – ensure the proper disposal of materials – immediately respond to reminders about the use of safety precautions – willingly wear proper safety attire without having to be reminded – assume responsibility for their involvement in a breach of safety or waste disposal procedures – stay within their own work area during an activity, respecting others' space, materials, and work – take the time to organize their work area so that accidents can be prevented – immediately advise the teacher of spills, breaks, and unusual occurrences, and use appropriate techniques, procedures, and materials to clean up – clean their work area during and after an activity – seek assistance immediately for any first aid concerns like burns, cuts, or unusual reactions – keep the work area uncluttered, with only appropriate materials present

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

From grades 10-12 It is expected that students will be encouraged to…

Appreciation of science	**Interest in science**	**Scientific inquiry**
436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not 437 appreciate that the applications of science and technology can raise ethical dilemmas 438 value the contributions to scientific and technological development made by women and men from many societies and cultural backgrounds ***Evident when students, for example,*** – consider the social and cultural contexts in which a theory developed – use a multi-perspective approach, considering scientific, technological, economic, cultural, political, and environmental factors when formulating conclusions, solving problems, or making decisions on an STSE issue – recognize the usefulness of being skilled in mathematics and problem solving – recognize how scientific problem solving and the development of new technologies are related – recognize the contribution of science and technology to the progress of civilizations – carefully research and openly discuss ethical dilemmas associated with the applications of science and technology – show support for the development of information technologies and science as they relate to human needs – recognize that western approaches to science are not the only ways of viewing the universe – consider the research of both men and women	439 show a continuing and more informed curiosity and interest in science and science-related issues 440 acquire, with interest and confidence, additional science knowledge and skills, using a variety of resources and methods, including formal research 441 consider further studies and careers in science- and technology-related fields ***Evident when students, for example,*** – conduct research to answer their own questions – recognize that part-time jobs require science- and technology-related knowledge and skills – maintain interest in or pursue further studies in science – recognize the importance of making connections between various science disciplines – explore and use a variety of methods and resources to increase their own knowledge and skills – are interested in science and technology topics not directly related to their formal studies – explore where further science- and technology-related studies can be pursued – are critical and constructive when considering new theories and techniques – use scientific vocabulary and principles in everyday discussions – readily investigate STSE issues	442 confidently evaluate evidence and consider alternative perspectives, ideas, and explanations 443 use factual information and rational explanations when analysing and evaluating 444 value the processes for drawing conclusions ***Evident when students, for example,*** – insist on evidence before accepting a new idea or explanation – ask questions and conduct research to confirm and extend their understanding – criticize arguments based on the faulty, incomplete, or misleading use of numbers – recognize the importance of reviewing the basic assumptions from which a line of inquiry has arisen – expend the effort and time needed to make valid inferences – critically evaluate inferences and conclusions, cognizant of the many variables involved in experimentation – critically assess their opinion of the value of science and its applications – criticize arguments in which evidence, explanations, or positions do not reflect the diversity of perspectives that exist – insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position taken can be judged – seek new models, explanations, and theories when confronted with discrepant events or evidence

Common Framework of Science Learning Outcomes K-12
Attitude Outcome Statements

For grades 10-12 It is expected that students will be encouraged to…

Collaboration	Stewardship	Safety
445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Evident when students, for example,*** – willingly work with any classmate or group of individuals regardless of their age, gender, or physical and cultural characteristics – assume a variety of roles within a group, as required – accept responsibility for any task that helps the group complete an activity – give the same attention and energy to the group's product as they would to a personal assignment – are attentive when others speak – are capable of suspending personal views when evaluating suggestions made by a group – seek the points of view of others and consider diverse perspectives – accept constructive criticism when sharing their ideas or points of view – criticize the ideas of their peers without criticizing the persons – evaluate the ideas of others objectively – encourage the use of procedures that enable everyone, regardless of gender or cultural background, to participate in decision making – contribute to peaceful conflict resolution – encourage the use of a variety of communication strategies during group work – share the responsibility for errors made or difficulties encountered by the group	446 have a sense of personal and shared responsibility for maintaining a sustainable environment 447 project the personal, social, and environmental consequences of proposed action 448 want to take action for maintaining a sustainable environment ***Evident when students, for example,*** – willingly evaluate the impact of their own choices or the choices scientists make when they carry out an investigation – assume part of the collective responsibility for the impact of humans on the environment – participate in civic activities related to the preservation and judicious use of the environment and its resources – encourage their peers or members of their community to participate in a project related to sustainability – consider all perspectives when addressing issues, weighing scientific, technological, and ecological factors – participate in social and political systems that influence environmental policy in their community – examine/recognize both the positive and negative effects on human beings and society of environmental changes caused by nature and by humans – willingly promote actions that are not injurious to the environment – make personal decisions based on a feeling of responsibility toward less privileged parts of the global community and toward future generations – are critical-minded regarding the short- and long-term consequences of sustainability	449 show concern for safety and accept the need for rules and regulations 450 be aware of the direct and indirect consequences of their actions ***Evident when students, for example***, – read the label on materials before using them, interpret the WHMIS symbols, and consult a reference document if safety symbols are not understood – criticize a procedure, a design, or materials that are not safe or that could have a negative impact on the environment – consider safety a positive limiting factor in scientific and technological endeavours – carefully manipulate materials, cognizant of the risks and potential consequences of their actions – write into a laboratory procedure safety and waste-disposal concerns – evaluate the long-term impact of safety and waste disposal on the environment and the quality of life of living organisms – use safety and waste disposal as criteria for evaluating an experiment – assume responsibility for the safety of all those who share a common working environment by cleaning up after an activity and disposing of materials in a safe place – seek assistance immediately for any first aid concerns like cuts, burns, or unusual reactions – keep the work station uncluttered, with only appropriate lab materials present

New Brunswick Department of Education

Daily Teaching Guide

Biology 11

(levels 1 and 2)

June 2008

Document # 844290

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Table of Contents

BIOLOGY 11/12 OVERVIEW

The Biology 11 and Biology 12 programs explore the unity and the diversity among living things. In Biology 11, students study the cell as the basic unit of life and the diversity of organisms that make up World's ecosystems. They also study some of the systems that allow multicellular organisms to maintain equilibrium as they interact with the outside environment. In Biology 12, students begin to focus on Biology at a molecular level. They study how organisms grow and pass along characteristics to future generations, and then how this impacts at the species and population level. They also pick up from grade 11 with the study of more systems that allow multicellular organisms to maintain equilibrium internally and with their environment. In both programs students investigate the impact of biology and technology on society and the impact of human activities on the natural world. A suggested sequence is presented but can be altered as preferred.

BIOLOGY 11 Quick Start Guide

This Quick Start Guide gives a summary of the grade 11 biology course, linking the knowledge outcomes together as part of a continuing story of human discovery of structures, functions and evolutionary trends of living organisms. As much as possible students should learn about how and when our present scientific understanding developed, and what questions we need to ask next.

Unit 1: The Cell *(24 hrs.)*

In this unit, students will observe the historical use of scientific method to search for the origin of organisms, the development of microscope technologies, the discovery of cells as basic units of life and the development of a cell theory. Eukaryotic cell structures and their interactive functions will be investigated in detail including a basic introduction to respiration and photosynthesis.

1. The Development of Cell Theory - describe the contributions of early scientists in discrediting the concept of spontaneous generation (abiogenesis), and in developing the modern cell theory. Describe how scientific understanding was enhanced or revised as a result of the invention of the microscope. *(4 hours)*

2. Microscope techniques – review and learn proper microscope techniques in preparation for a study of cells. Learn microscope parts and their function, microscope care and safety, focusing technique. Demonstrate the ability to properly display (i.e. draw) microscope images using line diagrams, and demonstrate the ability to prepare and stain a wet mount. *(3 hours)*

3. A Closer Look at Cells – explore, using microscopes and/or images, a variety of prokaryotic and eukaryotic cells. Identify the structures that make up eukaryotic cells and describe their functions - *nucleus, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, vesicles, chromosomes, lysosomes, microtubules and microfilaments, mitochondria, chloroplast, plasma membrane.* Identify ways in which plant and animal cells differ. Introduce how the cell uses proteins, carbohydrates and lipids. *(7 hours)*

4. Photosynthesis and Respiration – Describe the structure and functioning of *mitochondria and chloroplasts*, and develop a basic understanding of the involvement of these organelles in cell respiration and photosynthesis. *(5 hours)*

5. Cell Membranes - Describe the structure and function of the *plasma membrane*, including passive and active transport, endocytosis and exocytosis, semi-permeability and osmosis, the fluid mosaic model, and limits to cell size. *(5 hours)*

Unit 2: Biodiversity *(37 hrs.)*

This unit provides an overview of life's unity and diversity within the biosphere. The development of binomial nomenclature is explored as a systematic way to classify the vast diversity of living things. Students compare the structure, physiology, and life cycles of organisms between and within domains and kingdoms, and study the structural differences between phyla with reference to adaptations to the environmental niche occupied. An overview of classification can be found in Appendix 1 (Biodiversity Chart). The unit finishes with a study of the role of biodiversity in New Brunswick ecosystems, and the impact of human activities on these ecosystems.

1. Principles of taxonomy – explore the history, value and future of taxonomy, and the techniques used to classify organisms from a domain to a species level. *(5 hours)*

2. Characteristics of Major Groups – explore the characteristics of living things, the unique categorization of viruses, and the characteristics of each of the 6 Kingdoms. *(7 hours)*

    - Describe the life cycle and impact on humans, of viruses and of a selection of representative species from the Kingdoms Archaebacteria, Eubacteria, Protista and Fungi.

3. A More Detailed Look at Plants and Animals – a more in-depth study of the Kingdoms Plantae and Animalia.

    - For plants *(8 hours)*, study the characteristics of the Kingdom Plantae, and then representative life cycles, distinguishing characteristics, structures and reproductive strategies as evolutionary trends of four Phyla - the Mosses, Ferns, Gymnosperms and Angiosperms.

    - For animals *(12 hours)*, study the characteristics of the Kingdom Animalia and then the distinguishing characteristics and evolutionary trends of the eight invertebrate phyla found in the animal kingdom.

        Continue the study of the animal Kingdom towards a deeper understanding of the phyla Arthropoda and Chordata.

        - In Arthropods study the characteristics of the class Insecta and their success in exploiting a wide range of environmental niches.
        - In the Chordates, study the unifying characteristics and evolutionary trends of Fishes, Amphibians, Reptiles, Birds and Mammals.

4. Biodiversity of ecosystems – Consider the value of biodiversity in relation to the equilibrium and sustainability of ecosystems in New Brunswick. Study the province's eco-regions and their unique blend of biodiversity, climate and physical geography. Identify and discuss the impact of humans on this biodiversity. *(5 hours)*

Unit 3: Maintaining Dynamic Equilibrium (I) *(29 hrs.)*

All living things struggle to maintain an internal balance in response to the constant changing nature of the external environment. This unit investigates the role of specific systems in providing for the needs of cells of multicellular organisms to carry on living processes while maintaining homeostasis.

Homeostasis – explore the maintenance of homeostasis in terms of long-term adaptations, and lifetime responses, both in plants and in the human system. *(2 hours)*

Digestive and Excretory Systems – First explore the chemistry of the human body and the nutrients and energy delivered by the digestive system to each cell. Describe the structures of the human digestive system and their functions as nutrients are broken down and absorbed into the bloodstream. Describe the structure and function of the excretory system as waste is processed. Describe the requirements of a healthy diet, the results of malnutrition, and diseases of the Digestive system. *(12 hours)*

Circulatory and Respiratory System – Describe the structure of the human circulatory system, how gases and nutrients are delivered to cells throughout the body, and how the circulatory system helps to maintain homeostasis. Describe the mechanics of human breathing, lung structure and function, gas exchange with the bloodstream, and respiratory disorders. *(8 hours)*

Immune system – Describe the structure and functioning of the immune system as it defends the body from foreign organisms. Describe immune system disorders and diseases, their causes, and prevention. *(7 hours)*

Instructional Planning Guide
for Prentice Hall "Biology" 2008 by Miller and Levine

Unit - Suggested Time	# hrs	Text Sections	Text pages	Suggested activities
Unit 1 The Cell *(24 hrs.)*				**PH "Biology" text** **PHSchool.com webCode**
The development of cell theory	*4*	*1-2, 7-1*	*pp. 8-12, 168-172*	*"Writing in Science" p.171* **cbe-1012/ cbp-1012** **cbn-3071**
Microscope techniques	*3*	*Appendix D*	*pp.1070-1071*	*"Exploration" p.29* ***Lab Manual A**, pp.35-40*
A closer look at cells	*7*	*7-1, 7-2, 7-4*	*pp.172-181* *pp.190-193*	*"Quick Lab" p.180* *"Exploration" pp. 194-195* ***Lab Manual A**, pp.101-105* **cbe-3072/ cbp-3072** **cbb-3074**
Photosynthesis and respiration	*5*	*8-1, 8-2, 8-3, 9-1, 9-2*	*pp.200-209, 220-222, 232*	*"Writing in Science" p.205, 207* *"Quick Lab" pp. 206, 231* *"Analyzing Data" p. 213* *"Design an Experiment" p.215* ***Lab Manual A** pp.91-99* **cbd-3081** **cbe-3091/ cbp-3091**
Cell membranes	*5*	*7-3*	*pp.182-189, 241-243*	*"Quick Lab" p.187, p.242* *"Analyzing Data" p.188* ***Lab manual A** pp. 85-89* **cbn-3073** **cbe-3073/ bp-3073** **cbe-3075/ cbp-3073** **cbe-3076/ cbp-3076** **cbd-3101**

Instructional Planning Guide
for Prentice Hall "Biology" 2008 by Miller and Levine con't

Unit - Suggested Time	# hrs	Text Sections	Text pages	Suggested activities
Unit 2 Biodiversity *(37 hrs.)*				***PH "Biology" text PHSchool.com webCode***
Principles of Taxonomy	*5*	*18-1,18-2 Appendix F*	*pp. 446-455, 1078-1083*	*"Writing in Science" p.450* *"Quick Lab" p.453* *"Thinking Visually" p.455* *"Technology and Society" p.456,* *"Real World Lab" pp.462-263* *"Field Trip" p. 1079, 1081* ***Lab Manual A*** *p.147-152* **cbn-5181, cbe-5189/ cbp-5182**
Characteristics of Major Groups	*7*	*1-3, 19-2, 18-3, Appendix E*	*pp.15-18, 457-461, 478-490, 1072-1077*	*"Quick Lab" p.18, p.482* *"Focus on the Big Idea" p.461, 483* *"Issues in Biology" p.484* *"Writing in Science" p.487, 490* *"Exploration" p.491* *Appendix F p.1081-1083* ***Lab Manual A*** *p.195* **cbn-5183, cbe-6192, cbe-6192/ cbp-6192, cbb-6195**
A more detailed look at plants and animals	*8*	*Plants: 22-1, 22.2, 22-3, 22-4, 22-5, 25-2, 25-3*	*pp.550-572, 612-613, 639-646*	*"Problem Solving" p.553* *"Focus on the Big Idea" p.555, 642* *"Writing in Science" p.559* *"Thinking Visually" p.563, 572, 646* *"Quick Lab" p.565, 613, 640* *"Sharpen your Skills" p.568* *"Exploration" p.573* ***Lab Manual A*** *pp. 171, 177, 183, 189, 207* **cbe-7222/ cbp-7222, cbn-7221, cbd-7222, cbn-7224, cbn-7223, cbe-7252/ cbp-7252, , cbb-7225, cbe-7249/ cbp-7241**
	12	*Invertebrates: 29-1, 29-2* *Arthropods: 28-1, 28-2, 28-3* *Chordates: 30-1, 33-1, 33-2, 33-3*	*pp. 744-758* *pp. 715-719, 725-733* *pp. 766-770, 848-864*	*"Problem Solving" p.750* *"Quick Lab" p.753, 718, 775, 861* *"Thinking Visually" p.758, 856* *"Design an Experiment" p.759, 211, 739,* *"Focus on the Big Idea" p.719, 852* *"Sharpen your Skills" p.725* *"Writing in Science" p.731, 733, 770, 864* *"Analyzing Data" p.855* *"Exploration" p.790, 865* *"Issues in Biology" p. 853* ***Lab Manual A*** *p 201, 237* ***Lab Manual B****, p.181* **cbe-8299/ cbp-8291, cbn-8292, cbn-8281, cbn-9301, cbn-9331, cbn-9332 cbe-9333/ cbp-9333, cbb-9333**
Biodiversity within ecosystems	*5*	*6-3, 5-3, 6-1*	*pp.150-156, 138-149*	*"Quick Lab" p. 153* *"Writing in Science" p.155, 149* *"Focus on the Big Idea" p 156* *"You and Your Community" p.143* ***Lab Manual B****, pp.187-191* **cbn-2063, cbn-2061, cbe-2069/ cbp-2062**

Instructional Planning Guide
for Prentice Hall "Biology" 2008 by Miller and Levine con't

Unit - Suggested Time		# hrs	Text Sections	Text pages	Suggested activities
Unit 3 Maintaining Dynamic Equilibrium *(29 hrs.)*					**PH "Biology" text** **PHSchool.com webCode**
Homeostasis		*2*	*35-1*	*pp.890-896*	*"Thinking Visually" p.896*
Digestive system	*the chemistry of nutrition*	*5*	*2-3, , 38-1*	*pp.44-53, 970-977*	*"Design an Experiment" pp.990* *"Quick Lab" p.982* *Lab Manual B, pp.243-246* **cbe-1024, cbe-0381 (American)**
	the process of digestion and excretion	*7*	*2-4, 38-2, 38-3*	*pp.49-55, 978-984, 985-989*	*"Analyzing Data" p.51* *"Design an Experiment" pp.54*
Circulatory and Respiratory system		*8*	*37-1, 37-3, 40-3*	*pp.942-955 pp. 956-963, 1044*	*"Inquiry Activity" p.942* *"Writing in Science" p.949, 950* *"Analyzing data" p.954* *"Quick Lab" p.960* *"Design an experiment" pp.964* ***Lab manual A*** *p.261* ***Lab Manual B****, pp.239* **cbe-0373, cbe-0371**
Immune system		*7*	*40-1, 40-2, 40-3*	*pp.1030-1047*	*"Real World Lab" p. 1055* ***Lab Manual B****, pp. 253-56*

The Four Column Spread

This curriculum document is intended as a guide to the required topics and skills to be covered in the New Brunswick Biology 11 course.

Column one identifies all learning outcomes for Biology 112/111. Following each outcome is a bracketed list of numbers which refers back to the "**Pan-Canadian Specific Curriculum Outcomes**" at the beginning of each unit.

In Column one, "***NB Prescribed Outcomes***" are required for all students. Those outcomes identified under "***Biology 111***" are required extensions of the course material for all those taking the level 1 course option. This enriched curriculum should take the form of increased depth of understanding and greater development of investigative techniques rather than an increase in factual knowledge. If chosen, those outcomes identified as "***Optional***" should only be undertaken after completing the other outcomes.

In Column two, "**Elaborations**", are meant to clarify the level of detail and approach to take with reference to each of the prescribed outcomes. "**Teaching Suggestions**" are optional and intended to illustrate by example the approach one could take in teaching the outcomes.

In Column three, "**Tasks for Instruction and Assessment**", presents further suggestions for instruction and assessment to use and should be considered optional.

Column four, "**Notes**", provides references to the prescribed text and supporting resources specific to each topic. ***PHBiology*** refers to the 2008 edition of Prentice Hall "Biology" by Miller and Levine. Codes listed ***(e.g. cbp-1012)*** refer to on-line links to resources accessible at http://phschool.com/ ***Laboratory manuals A*** *and* ***B*** refer to the ancillary resources for Prentice Hall "Biology".

In addition to the resources linked to the prescribed text teachers should refer often to the NB Government Education Portal at https://portal.nbed.nb.ca/ for current internet links and shared teacher resources sorted by specific topic.

These resources should be considered a starting point - teachers are encouraged to add other resources as appropriate.

BIOLOGY 11

UNIT 1 - The Cell

Introduction

The word "biology" is one that can be defined simply as the study of life. However, the study of biology is far from simple, and is as complex and diverse as living things are complex and diverse. Living things are much more than physical machines or a mere set of chemical reactions. They are composed of individual units called cells. Cells are considered to be the basic unit of structure and function displaying the characteristics of life. During this unit, the historical development of the cell theory and the role of the microscope in the advancement of biological knowledge will be discussed. Students will gain an appreciation for the complexity of life at the cellular level of organization and the delicacy of interactions between components at this level as they study cell structures and their functions.

Curriculum Focus

In its consideration of the cell as the fundamental unit of life, the focus of this unit is placed within the area of **scientific inquiry**. This involves primarily an emphasis on **observation and inquiry.** Sections within this unit ask students to consider structures, processes and interactions within cells and to gain familiarity with basic laboratory techniques.

Curriculum Links

This preliminary discussion of cells builds upon clusters of information that have preceded it in the student's earlier study of the science curriculum. Characteristics and needs of living things and their dependence on the environment are first introduced in a general format in Grade 1. This base is built upon with the discussion of the interaction of plants with the environment in Grade 3. Students in Grade 6 begin to become familiar with the use of magnifying tools to observe micro-organisms. By the end of the Grade 8 level, students have been introduced to plant and animal cells as living systems exhibiting the characteristics of life. In addition, structural and functional relationships between cells, tissues, organs and body systems and their relationship to the functioning of the human organism as a whole have been investigated. In grade 9 students look more closely at the nucleus and the genetic material involved in reproduction.

Unit 1- The Cell
Pan-Canadian Specific Curriculum Outcomes

STSE

Nature of Science & Technology

114-1 Explain how a paradigm shift can change scientific world views.

114-2 Explain the role of evidence, theories, and paradigms in the development of scientific knowledge.

114-9 Explain the importance of communicating the results of a scientific or technological endeavour, using appropriate language and conventions.

115-5 Analyze who and how a particular technology was developed and improved over time.

116-2 Analyze and describe examples where scientific understanding was enhanced or revised as a result of the invention of a technology.

116-6 Describe and evaluate the design of technological solutions and the way they function, using scientific principles.

SKILLS

Initiating & Planning

212-7 Formulate operational definitions of major variables.

Performing and Recording

213-2 Carry out procedures controlling the major variables and adapting or extending procedures where required.

213-3 Use instruments effectively and accurately for collecting data.

213-5 Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data.

213-8 Select and use apparatus and materials safely.

Analyzing & Interpreting

214-1 Describe and apply classification systems and nomenclatures used in the sciences.

214-3 Compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots

214-11 Provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion.

Communication & Teamwork

215-6 Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise.

KNOWLEDGE

314-5 Explain the Cell theory

314-6 Describe cell organelles visible with the light and electron microscopes.

314-7 Compare and contrast different types of prokaryotic and eukaryotic cells.

314-8 Describe how organelles manage various cell processes such as ingestion, digestion, transportation, and excretion.

314-9 Compare and contrast matter and energy transformations associated with the processes of photosynthesis and aerobic respiration.

The Development of Cell Theory

(4 hours)

NB Prescribed Outcomes

It is expected that students will:

- Describe the contribution of early scientists in discrediting the concept of spontaneous generation (abiogenesis) in favour of biogenesis. (114-1, 114-2, 114-9)

- Describe the contribution of early scientists in development of the cell theory and have a good understanding of the cell theory. (314-5, 116-2)

- Analyze and describe how scientific understanding was enhanced or revised as a result of invention of the microscope. (116-2)

Biology 111

- Research and discuss examples of abiogenisis versus biogenisis in which the bias of the investigators affected outcomes.

Elaborations

An historical approach to the development of the concept of biogenesis illustrates the development and functioning of scientific thought and techniques, as students study the contributions of scientists such as Redi, Spallanzani, and Pasteur to the establishment of biogenesis.

The concept of spontaneous generation arose from faulty observations and a lack of experimental control. Through the use of controlled experiments biogenesis was supported and spontaneous generation discredited. This should be used as an opportunity to develop students' understanding of science skills, including the importance of controlled experiments.

Early cell biologists such as Robert Hooke, Anton van Leeuwenhoek, Schleiden, Schwann, and Virchow were instrumental in the discovery of cells as the basic unit of living organisms, and in the development of the cell theory.

Students should be able to link the advances of microscope technology to the development of cell theory, structure and functioning. This provides a good example of how scientific understanding has been advanced as a result of technological advances. Various microscopes should be compared with reference to terms of illumination, magnification, field of view dynamics and specimen preparation.

Optional

Opportunity exists here to link biology with physics, with a study of the basic technology of the electron microscope.

The Development of Cell Theory con't

Suggestions for Instruction and/or Assessment

Presentation (114-1, 114-2)
Provide your students with a list of individuals who have contributed historically to the development of the cell theory.
Collect information on the researcher assigned to you or your group and prepare a brief oral presentation to be given to the class. On the index cards provided outline in point form the individual's name, the time frame in which he or she worked, and their main contributions to the development of the cell theory. Presentations will be made in chronological order and the index cards affixed to a time line at the front of the class to chronicle the development of this theory.

Notes

***PH Biology** pp. 8-12, 168-172*
"Writing in Science" p.171

cbe-1012/ cbp-1012, cbn-3071

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Microscope Techniques

(3 hours)

NB Prescribed Outcomes

It is expected that students will:

- Demonstrate effective and accurate use of the light microscope including:
  - Parts and their function
  - General care
  - Focusing technique
  - Field of view calculation
  - Safety concerns

  (213-3, 213-8)

- Demonstrate the ability to prepare a wet mount of a specimen, including staining techniques. (213-3)

- Demonstrate the ability to display accurately, through line diagrams, information compiled through the use of the microscope. (213-5, 214-3)

Elaborations

In preparation for use of the microscope throughout their biology studies, students should review terminology and general care and safety of the microscope, and then be given ample time to explore the practical use of the microscope working with a variety of materials. This section must be done as a hands-on lab activity.

Students should become comfortable with specimen preparation, including wet-mount and staining techniques, focusing techniques, and effective presentation of their observations to others. Diagrams of the specimens viewed should include field of view and magnification, should accurately show what they have seen, and should follow correct protocol for biological drawings.

Optional

Should both a compound microscope and dissecting (stereo) microscope be available, it is a useful exercise to compare views of various specimens, as a way to bridge the abstract nature of the microscopic, with the common daily visual experience.

Teaching suggestion

The students can begin working with familiar objects (e.g. a printed letter such as “e” or “f” to illustrate inversion properties of the microscope), and work up to easily viewed objects (e.g. commercially prepared slides selected by the teacher or teacher prepared slides), and then to a variety of objects they select and prepare themselves for which the compound microscope may or may not be the appropriate tool (thinly vs. thickly sliced specimens, plant material, pond water, various foods, sand etc.).

Microscope Techniques con't

Tasks for Instruction and/or Assessment

This section involves an emphasis on hands on laboratory experiences.

Observation (214-3)
Now that we have completed our discussion on parts of the microscope, their purposes, safety features, and the focusing techniques, you will be assessed on your understanding through a demonstration. To demonstrate your competency, you will be observed as you prepare a wet mount of the material provided and will be expected to answer questions in an interview fashion.

Pencil & Paper (214-3)
Draw a line diagram of the specimen provided and label it properly. *Assessment of diagram will be based on completion of task, clarity and accuracy.*

Performance (214-3)
Prepare and stain a wet mount slide. A visual scan of your product will allow an assessment of your slide preparation and focusing techniques

Laboratory Activities (213-5, 213-8)
Following the procedures demonstrated and outlined on your lab sheet, use the microtome to prepare a section of the specimen provided. Fix and stain your specimen appropriately and view under the microscope.

Use the micro slide viewer to observe the slides provided. This is a way to view samples that cannot be viewed under a light microscope. Answer the assigned questions.

Notes

PH Biology *pp.1070-1071*
"Exploration" p.29

Lab Manual A*, pp. 35-40*

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

A Closer Look at Cells

(7 hours)

NB Prescribed Outcomes

It is expected that students will:

- Examine and compare the structure of prokaryotic and eukaryotic cells. (213-3, 214-1, 314-6, 314-7)
- Describe the differences between plant and animal cells. (214-1, 314-8)
- Describe eukaryotic cellular structures and the ways in which they manage various cell processes. Include: *nucleus, nucleolus, nuclear membrane, ribosomes, smooth and rough endoplasmic reticulum, Golgi apparatus, vesicles, chromosomes, lysosomes, microtubules and microfilaments, vacuoles, mitochondria, centrioles, chloroplasts, cell membranes and cell walls.* (314-6, 314-8)
- Examine and compare images of cell structure generated b both the light and electron microscopes. (115-5, 116-6, 314-6)

Elaborations

Skills in slide preparation and staining developed in the previous section should be used to view a variety of prokaryotic and eukaryotic cells. Examples could include: prokaryotic cells such as cyanobacteria, or *lactobacillus* in yogurt, and eukaryotic cells such as chloroplasts in spinach, leucoplasts in unripe banana, nucleus in yeast, nucleus, vacuole and cell wall in onion epithelium. They should recognize both the similarities and distinguishing characteristics of prokaryotic and eukaryotic cells, while at the same time recognizing the range of cell types within a given group.

Students should view a variety of plant and animal cells under the microscope, and use diagrams, models, or charts to illustrate and distinguish the structures of plant and animal cells. As when comparing prokaryotic and eukaryotic cells, students need to identify both the similarities and differences between plant and animal cells.

Micrographs produced by both transmission electron microscopes and scanning electron microscopes should be available for student examination. These will illustrate details of some cell structures that cannot be distinguished by students in a laboratory setting. Textbooks and websites are a good source of these.

Optional

Students could research the discovery of the structure and functions of cell organelles to answer questions such as: Who discovered the organelle and when? How was the function of the organelle discovered? Did the initial understanding change over time, and if so, how?

During the progression of Biology 11 & 12, it is appropriate to make students aware of the career opportunities that exist in various areas of this science (e.g. cytology or the study of cells as a component of laboratory technology).

Biology 111 Teaching Suggestion

As a classroom activity students can work on their own or in a group to act out “a day in the life of the cell”.

A Closer Look at Cells con't

Tasks for Instruction and/or Assessment

Homework Assignment (114-2, 115-5, 116-2, 314-6, 314-8**)**
Research the history of the discovery of the structure and functions of a cell organelle – either review printouts from the internet or text resources that the teacher has provided, or search on the internet yourself. Bring the printout to school prepared to share 3 or 4 key points with the class.

Questions to consider: Who discovered the organelle and when? How was the function of the organelle discovered? Did the initial understanding change over time, and if so, how?

Project (213-8, 214-3)
Create a model of a plant or animal cell and its structures using the parameters provided for you. *Assessment will be based on the accuracy and completeness of model.*

Paper & Pencil (215-6, 314-6, 314-7)
Individually or in groups of two, choose one of the following sets and prepare a chart to summarize the differences: Plant vs. animal cells

- Eukaryotic vs. prokaryotic cells
- Light microscope vs. scanning electron microscope
- Light microscope vs. transmission electron microscope
- Scanning electron microscope vs. transmission electron microscope

Laboratory Activities (213-2, 213-5, 213-8, 214-3, 214-11, 215-6)

Design and Implementation
Working in a group, research some aspect of plant and animal cells. Possible topics might include:

- Comparing the sizes or structures of cells from a variety of species
- Compare how the structure differs between cells from different areas of a plant.

Present your plan for approval. Your plan should include how you intend to organize yourselves, collect your data and control and measure the variables. You will be assessed on your understanding of the topic you are researching, the logic and practicality of your research plan, your experimental techniques, and your creativity in choosing a topic and designing the investigation.

Presentation
When the investigations have been completed, you can present your findings to the class. You should be able to explain the rationale behind your experiment and be able to answer questions on the data collected. You should also consider if there were any ways that your experimental design could have been improved, and what questions and further investigations might arise from your work.

Notes

PH Biology
pp.172-181, .190-193

"Quick Lab" p.180
"Exploration" pp. 194

***Lab Manual A**, pp.101-105*

cbe-3072/ cbp-3072
cbb-3074

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Photosynthesis and Respiration

(5 hours)

NB Prescribed Outcomes

It is expected that students will:

- Describe the structure of mitochondria, and chloroplasts. (314-6)
- Compare and contrast the basic matter and energy transformations associated with the processes of photosynthesis and aerobic respiration. (314-9)
- Demonstrate that photosynthesis and aerobic respiration are complementary processes. (314-9)

Elaborations

In the previous section students will have identified mitochondria as present in all cells, and chloroplasts as present only in plant cells and some protists.

As the cell and structure of mitochondria is studied, students should identify the sites of glycolysis, Krebs cycle and electron transport as part of respiration. Students should gain a basic understanding of cellular respiration as the breakdown of stored chemical energy (glucose) into easily released chemical energy (ATP) which can then be used to power cell activities such as movement and the building of molecules. Oxygen is necessary for respiration, and carbon dioxide, water, and heat are released as by-products.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy (heat or ATP)

As the structure of chloroplasts is studied, links should be made to its function as the site of photosynthesis. Students should gain a basic understanding of photosynthesis as the conversion of solar energy into stored chemical energy (glucose), which is then available to be broken down through respiration to power cell activities. Carbon dioxide and water are necessary for photosynthesis, and oxygen and water are released as by-products.

$6CO_2 + 12\ H_2O$ + light $\rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

Biology 111

Biology 111 Elaborations

Students should begin to investigate respiration and photosynthesis at a biochemical level (Krebs cycle, glycolysis, fermentation and light and dark reactions associated with plants) always keeping sight of the context of these reactions.

Choose one of the following:

- Design and perform experiments to investigate photosynthesis and respiration (213-2, 213-3, 213-5, 214-3, 215-6)

OR

- Explain the importance of the processes of photosynthesis and aerobic respiration to human enterprises. (116-6, 214-3, 214-11, 314-9)

Laboratory experiments can be designed and performed by students to investigate photosynthesis and respiration. Results should be recorded and could then be presented to the class as a poster or oral presentation.

OR

An analysis of the role of photosynthesis as the biological basis of the primary industries of agriculture, forestry and the fisheries would be appropriate. This may lead to discussion or research into how the pressures of human population have impacted the natural balance between photosynthesis and respiration through burning of fossil fuels, deforestation, depletion of ocean resources, and the input of synthetic fertilizers.

Photosynthesis and Respiration con't

Tasks for Instruction and/or Assessment

Paper & Pencil (212-7, 213-2, 214-3, 214-11, 314-9)
Prepare a demonstration to illustrate the consumption of CO_2 or production of O_2 by a water plant found in a local pond/stream or pet store or to monitor the production of O_2 bubbles vs. light intensity. Record your observations and an explanation for them in scientific terms.

PH Biology *pp.200-209, 220-222, 232*
"Writing in Science" p.205, 207
"Quick Lab" pp. 206, 231
"Analyzing Data" p.213,
"Design an Experiment" p.215

Lab Manual A *pp.91-99*

cbd-3081
cbe-3091/ cbp-3091

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Biology 111 Tasks for Instruction and Assessment

Choose one of the following projects:
Project 1 - laboratory Activities
(212-7, 213-2, 213-5, 214-3, 214-11, 215-6, 314-9)
Development and implementation of experiment
As a group choose a topic to investigate. Possibilities might include:

- Production of starch by the leaves of plants.
- Starch production within variegated leaves (*Coleus).*
- Variety of pigments found in the leaves of plants.
- Colour (wavelength) of light that is most useful for photosynthesis in geranium leaves.
- Respiration in germinating plant seeds compared to boiled seeds.
- Production of heat as a by-product of respiration in living organisms.

Discuss within your group plans for your experimental design and how you intend to proceed, measure variables and record data. You must illustrate understanding of the task at hand, development of a hypothesis and a workable plan, clarity of thought and logical creativity. As you carry out your experiment you will be assessed as to whether you followed your design, used correct techniques, worked safely, and made necessary changes if needed during the experiment.

Based on this experiment, design a follow up experiment to answer a question that arose from this experiment. You will be evaluated for completeness, originality and logical thought.

Presentation
When the experiments have been completed, you will present your data and conclusions to the class. Be prepared to explain your experimental design and why you made certain decisions during the planning and implementation.

Project 2 - presentation (114-9, 116-6) Using print or electronic resources, research some of the effects that human manipulation has had upon the natural balance of the processes of photosynthesis and respiration within the environment. Suggested concepts for presentation and subsequent discussion could include:

- Selective breeding of crop plants to increase productivity.
- Addition of fertilizer nutrients to water systems
- Deforestation of old growth forests.
- Dependence of global population on consumption of fossil fuels.
- Dependence on tropical deforestation to support the production of meat

Present your findings in a report format or point form.

Notes

Cell Membranes

(5 hours)

NB Prescribed Outcomes

It is expected that students will:

- Explain how materials are able to move into and out of cells through a selectively permeable membrane. Include:
  - *fluid mosaic model*
  - *passive transport – osmosis, diffusion and facilitated diffusion*
  - *active transport – molecular transport, endo- and exocytosis* (314-8)

- Describe the effects of osmosis on cells with and without cell walls. (314-8)

- Carry out procedures to investigate the relationship between membrane surface area and cell size and summarize your findings. (212-7, 213-2, 214-11, 215-6)

Elaborations

Passive transport includes osmosis, diffusion, and facilitated diffusion. Students should explore the relationship between some familiar situations and osmosis and diffusion (hypertonic, hypotonic and isotonic solutions).

Active transport includes molecular transport, endocytosis, and exocytosis. Students should be clear of the mechanics of each of these processes and the important ways that active transport differs from passive transport.

Students should investigate the relationship between surface area and volume and explain why this would limit the size of cells.

Teaching suggestions

Passive transport can be demonstrated in the classroom by setting up and/or having students set up and observe concentration gradients across membranes – both artificial (dialysis tubing) and natural (animal or plant cells). Examples include food preservation with sugar or salt, the adverse effect of too much fertilizer on plants, the reason that vegetables are sprayed with water at local grocery stores, and the use of intravenous fluids in medical situations, and the reason why you shouldn't drink sea water.

The relationship between surface area and volume can be modelled with dye absorption experiments. It can also be investigated mathematically using the chart below.

Surface to Volume Relationship in Cell Growth

Radius of Sphere	Surface Area $4\pi r^2$	Volume $4/3\pi r^3$	Surface/ Volume Ratio
1			
2			
3			
4			
5			

Biology 111 Teaching suggestion

Students can be asked to design an experiment which further explores osmosis and diffusion.

Cell Membranes con't

Tasks for Instruction and/or Assessment

Paper & Pencil (314-8)

Observe the demonstrations prepared on osmosis and/or diffusion and explain in scientific terms the observations you make based upon your understanding of these concepts.

Investigate one of these everyday situations related to osmosis and diffusion (hypertonic, hypotonic and isotonic solutions) individually or in groups. You may also select an original scenario, upon approval by teacher. Record your findings, and be prepared to present them to the class.

- Food preservation
- Wilting of plants
- Effects of too much fertilizer on plants
- Why IV's must contain isotonic solutions
- Difficulties that must be dealt with as fish (salmon) move from fresh to salt water or vice versa

Laboratory Activities (213-2, 213-5, 213-8, 214-3, 214-11, 215-6, 314-8)
Perform the experiment assigned to investigate the relationship between cell surface area and cell size, and complete the evaluation requirement as indicated.

A variety of potential experimental methods exist. Students may be asked to turn in a laboratory write-up, answer questions based on the relationships seen through the laboratory work, or to discuss additional potential difficulties that cells may experience as they increase in size.

Biology 111 Tasks for Instruction and/or Assessment

Laboratory Activities (213-2, 213-5, 213-8, 214-3, 214-11, 215-6, 314-8)
Propose a hypothesis and then design and carry out a controlled experiment to determine whether surrounding a model cell with particular molecules will result in net movement of water by osmosis or in diffusion of the molecules themselves. Dialysis tubing can be used to simulate the plasma membrane.

Based on this lab experience, students could suggest and/or design an experiment that would help to answer a question that arose from their work. This could be evaluated for completeness, originality and logical thought processes.

Notes

***PH Biology** pp.182-189, pp.241-243*

"Quick Lab" p.187, .242
"Analyzing Data" p.188

***Lab manual A** pp. 85-89*

cbn-3073
cbe-3073/ bp-3073
cbe-3075/ cbp-3073
cbe-3076/ cbp-3076
cbd-3101

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BIOLOGY 11

UNIT 2 - Biodiversity

Introduction

Approximately one and one-half million types of organisms are known today, with more constantly being identified. The opinions of scientists range anywhere from the possibility of ten to thirty million as being the total number of species actually in existence. Dealing with a system as large and widespread as this requires a taxonomic organizational structure to allow scientists and students to investigate the types and characteristics of these living things. This unit introduces Linnaeus' modern classification system as a basis for this study.

Organisms exhibit a huge range of diversity, yet maintain a number of basic things in common. An appreciation for this paradigm is encouraged as students are given the opportunity to experience the array of organisms within a logical survey of the taxonomic categories of life, and investigate their anatomy, physiology and life cycles. A survey of the world's organisms would not be complete without a study of the significance of biodiversity in sustaining the world's ecosystems, and the anthropological effects on this biodiversity. Through research into current issues, students are encouraged to explore the relationship between humans and the ecosystems which support all life.

Curriculum Focus

This unit on biodiversity contains an emphasis on **scientific inquiry** and **observation**. There are ample opportunities for students to sample and gain an appreciation for the diversity and complexity of life on earth through their investigation of the classification of these living things.

Curriculum Links

Students begin looking at different examples of living things, and how we depend on our environment in Grade 1. Life cycles of familiar animals and the environments that support them are compared in Grade 2 with the life cycles of plants introduced in Grade 3. The major focus in Grade 4 is on habitats and community including the identification of regional and local habitats and how the removal of plant or animal populations would affect the remainder of the community. Within Grade 6 the concept and importance of classification systems and the diversity of living things are discussed. At this level students compare characteristics of common mammals, birds, reptiles, fishes and arthropods. In Grade 7 diversity of life and their interactions within ecosystems is discussed, and students are introduced to biotic and abiotic factors, the flow of energy within an ecosystem, and ecological succession. In Grade 10 students take a more in-depth look at the sustainability and the dynamics of ecosystems as matter is cycled and natural populations are kept in equilibrium in relation to the availability of resources, and some of the many factors that can disrupt sustainability

.

Unit 2 – Biodiversity
Pan-Canadian Specific Curriculum Outcomes

STSE (Science, Technology, Society and Environment)

Nature of Science & Technology.
114-5 Describe the importance of peer review in the development of scientific knowledge.

115-7 Explain how scientific knowledge evolves as new evidence comes to light and as laws and theories are tested and subsequently restricted, revised, or replaced.

Relationships between Science & Technology
116-2 Analyse and describe examples where scientific understanding was enhanced or revised as a result of the invention of a technology.

116-7 Analyse natural and technological systems to interpret and explain their structure and dynamics.

Social & Environmental Contexts of Science & Technology.
118-6 Construct arguments to support a decision or judgment, using examples and evidence while recognizing various perspectives.

SKILLS

Initiating & Planning
212-1 Identify questions to investigate that arise from practical problems and issues and then determine ways to investigate them.

212-6 Design an experiment and identify specific variables.

Performing & Recording
213-6 Use library and electronic research tools to collect information on a given topic.

213-8 Select and use apparatus and materials safely.

Analysing & Interpreting
214-1 Describe and apply classification systems and nomenclatures used in the sciences.

214-2 Identify limitations of a given classification system and identify alternative ways of classifying to accommodate anomalies.

214-3 Compile and display evidence and information, by hand or computer in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots.

214-5 Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables.

214-8 Evaluate the relevance, reliability, and adequacy of data and data collection methods.

214-9 Identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information.

214-10 identify and explain sources of error and uncertainty in measurement and express results in s form that acknowledges the degree of uncertainty.

214-15 propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan.

214-17 Identify new questions or problems that arise from what was learned.

Communication & Teamwork
214-4 identify a line of best fit on a scatter plot and interpolate or extrapolate based on the line of best fit.

215-1 Communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others.

215-2 Select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results.

215-3 Synthesize information from multiple sources or from complex and lengthy texts and make inferences based on this information.

KNOWLEDGE Outcomes

Con't next page….

KNOWLEDGE

313-1 Analyze and explain the life cycle of a representative organism from each kingdom, as well as of a representative virus.

316-4 Outline evidence and arguments pertaining to the origin, development, and diversity of living organisms on Earth.

316-5 Use organisms found in a local or regional ecosystem to demonstrate an understanding of fundamental principles of taxonomy.

316-6 Describe the anatomy and physiology of a representative organism from each kingdom, as well as from a representative virus.

317-1 Explain how different plant and animal systems, including the vascular and nervous systems, help maintain homeostasis.

317-8 Explain how behaviours such as tropisms, instinct, and learned behaviour help maintain homeostasis.

318-6 Explain how biodiversity of an ecosystem contributes to its sustainability.

318-7 Compare Canadian biomes in terms of climate, vegetation, physical geography, and location.

318-10 Evaluate Earth's carrying capacity, considering human population growth and its demands on natural resources.

331-6 Analyze the impact of external factors on an ecosystem

Principles of Taxonomy

(5 hours)

NB Prescribed Outcomes

It is expected that students will:

- Use organisms found in a local or regional ecosystem to demonstrate an understanding of the fundamental principles of taxonomy. (212-1, 316-5)
- Identify limitations inherent to any classification system. (214-2, 214-17)
- Understand the concept of binomial nomenclature as developed by Linnaeus and understand its advantages for the scientific community. (214-2)
- List, in order, levels of classification (taxa) based on increasingly narrower categories, using the species as the base identification level. (214-1)
- Explain how scientific classification systems are changing as new evidence concerning living things is being discovered. (114-5, 115-7, 116-2)

Biology 111

- Research modern techniques used for classification. (116-2, 213-6, 215-1)

Elaborations

This section provides a structural framework for the subsequent study of living things. Students should be given the opportunity to explore a variety of ordering and classification systems using organisms with which they are familiar, and from local or regional ecosystems.

The differences that arise as each group of students develop their own classification systems should become a springboard for discussions and further investigations regarding limitations inherent in any classification system. Students should develop a clear understanding of the concept of characteristics as similarities which are relevant in classification systems.

As students explore the ways in which organisms are classified, they should examine naming systems. They will be familiar with common names for some species but should realize the inadequacies and language problems associated with this method of identification. This will highlight the usefulness of a common international naming system and will prepare for a discussion on the Linnaean system of taxonomy using binomial nomenclature. They should learn how the Linnaean system first developed, and how it is used today.

The seven major categories of Linnaeus' classification system *(kingdom to species)* should be introduced. Students should gain an understanding that each taxon involves varying degrees of similarities and differences amongst the organisms that are found in it. It should be pointed out that superclass, suborder sometimes exist, adding additional layers of complexity to this system.

Students should learn to use a dichotomous key which will help increase their understanding of the importance of observations and other complexities of taxonomy. It is also a practical skill which can be extended outside the classroom.

Teaching Suggestions

Keys are commercially available, and/or students could design their own key, which could then subsequently be used by others in the class to identify specific items or organisms.

Biology 111

Students should be given an opportunity to explore newer techniques involved in the classification of organisms (e.g. cladistics, DNA/RNA comparisons, molecular clocks, radioactive dating, structural information, embryology, cellular structure or behaviour) and compare these techniques with the methods utilized by early scientists such as Aristotle or Linnaeus.

Principles of Taxonomy con't

Tasks for Instruction and/or Assessment

Laboratory Activities (214-2, 316-5)
Visit a locally accessible ecosystem and observe its organisms. Develop your own grouping system for what you observe. You will be asked for the rationale of your system of biological organization. *Assessment may be based on their thoroughness, logical thinking and explanations given for their techniques. A broad variety of methods of grouping may be evident.*

Investigation & Presentation (316-5)
Select one of the organisms you observed and investigate its classification utilizing Linnaeus' system. Be prepared to share this classification with other class members in a visual format.
Assessment can be based upon thoroughness and completeness.
Teacher should ensure that a wide variety of organisms are included.

Research & Presentation (115-7, 116-2, 213-6, 215-1)
Present the results of your research on modern classification techniques to the class. Use any appropriate format (oral, poster, computer presentation).
This may best be used as an enrichment activity.

Notes

PH Biology *pp.446-455, 1078-1083*
"Writing in Science" p.450
"Quick Lab" p.453
"Thinking Visually" p.455
"Technology and Society" p.456,
"Real World Lab" pp.462-263
"Field Trip" p. 1079, 1081

Lab Manual A *p.147-152*

cbn-5183, cbe-6192, cbe-6192/ cbp-6192, cbb-6195

Check NB Government Portal for current links and shared resources
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Characteristics of Major Groups

(7 hours)

NB Prescribed Outcomes

It is expected that students will:

- Develop a list of characteristics shared by living things. (118-6)
- Identify the general characteristics that distinguish the members of each recognized kingdom. (313-1, 316-6)
- Demonstrate an understanding that the recognized kingdoms of living things represent a diversity of organisms exhibiting extensive variety in terms of form and function. (316-6)
- Analyze and explain the major features of a virus and its reproductive cycle. (313-1, 316-6)

Elaborations

This discussion is intended as an overview to introduce students to the vast array of living organisms in the world, and how they relate to one another.

Students should recognize that although groups of living things are distinct in many ways, there are a number of characteristics that are shared and increase their chances of survival.

Students should identify the general characteristics that distinguish the members of Domains (Bacteria, Archaea & Eukarya) and Kingdoms. Students should be introduced to enough examples from each Kingdom (Eubacteria, Archaebacteria, Protists, Fungi, Plants, Animals) to recognize that even within Kingdoms organisms show wide diversity in form and function.

Examples should be selected from each kingdom and used to illustrate the major features of that Kingdom including: symmetry, cell and body structure, locomotion, nutrition, circulation, respiration, excretion and reproduction. Students should identify a variety of organisms and determine those characteristics which distinguish the kingdom to which they belong.

Students should explore the placement of viruses with reference to characteristics of living things, and the general structure and reproductive cycle of a virus (e.g. T4 virus). The impact of viruses and bacteria on human health will be further explored in the study of the human immune system in Unit 3.

Teaching suggestions

An effort should be made to use organisms that are easily available and/or indigenous to the local area and could include: *Lactobacillus* in yogurt, pond water organisms, yeast, mushrooms, mosses, flowers, grasshoppers, earthworm, starfish, perch, frogs, and pigs.

A variety of techniques including wet mounts, prepared slides, classification sets, models, specimens, dissections, computer simulations, etc. provide hands-on activities to reinforce student learning.

Biology 111 Elaborations

Students should explore replication pathways for other viruses e.g. HIV, herpes simplex.

Characteristics of Major Groups con't

Tasks for Instruction and/or Assessment

Laboratory Activities (215-1, 316-6, 313-1)
Observe the organisms provided as samples of members of each kingdom. Be sure to follow the directions specified for the use of the classification set, living or preserved specimens, dissections, computer simulation, or microscopy involving wet mounts or prepared slides.
Assessment can be accomplished in a laboratory format through the completion of proper lab diagrams or assignment questions.

Laboratory activities (316-6, 213-8, 214-1, 214-3)
Labs may include making yogurt (beneficial bacteria), a protist survey, growth and reproduction of fungus, plant embryonic development, and plant and flower structure.

A microscope lab could compare worms including parasitic and free living organisms such as sheep liver fluke, planarian, trichina worm, tapeworm, and round worm.

Dissection labs could include squid, earthworm, grasshopper, sea star and frog, illustrating a range of body forms.

Presentation (213-6, 215-1, 313-1, 316-6)
Select, with your teacher's guidance, a member of one of the Kingdoms that were discussed. Investigate, using library or electronic research the anatomy, physiology and life cycle of this organism and present the information on this organism to the rest of the class in the form of a model and/or poster and a brief oral report. Be sure to include any new or surprising pieces of information you may collect, and indicate where this organism might be found.
Teachers should ensure that there are a good variety of organisms selected within the class. Assessment should to be based on thoroughness and accuracy of visual and oral presentation.

Notes

PH Biology *pp.15-18, 457-461, 478-483,1072-1077*

"Quick Lab" p.18, p.482
"Focus on the Big Idea" p.461, 483
"Issues in Biology" p.484
"Writing in Science" p.487, 490
"Exploration" p.491
Appendix F p.1081-1083

Lab Manual A *p.195*

cbn-5183, cbe-6192, cbe-6192/ cbp-6192, cbb-6195

Check NB Government Portal for current links and shared resources
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A More Detailed Look at Plants

(8 hours)

NB Prescribed Outcomes

It is expected that students will:

- Describe the differences that exist between the major groups of plants (bryophytes, ferns, gymnosperms, angiosperms). (313-1, 316-4, 316-5, 316-6)
- Describe the structure and function of a flower, and compare the structure of monocot and dicot seeds. (316-4, 316-6)
- Dissect, compare and identify a variety of plant phyla. (316-4, 316-6)
- Dissect a variety of flower types and identify structures. (316-4, 316-6)
- Explain how plants maintain homeostasis with reference to tropisms and adaptations to harsh climates. (317-8)

Biology 111

- Students should design and carry out experiments on plant tropisms.
- Investigate the role played by plant hormones such as cytokinins, auxins and gibberellins.

Elaborations

The intention of this section is to survey a selection of plant phyla, with a focus on adaptations to a variety of environments.

For plants, the focus should be on four phyla – Bryophyta (mosses), Pterophyta (ferns), Coniferophyta (gymnosperms) and Anthophyta (angiosperms) - and the characteristics which distinguish them as different taxonomic groups.

Characteristics and life cycles should be studied with reference to being progressively less dependent on immersion in water. With this focus, students should study vascular systems, physical barriers to water loss (e.g. cuticle, stomata), and reproductive cycles and strategies, including the structure and functioning of flowers, seeds, and fruits.

Connections should be made between the adaptability of Angiosperms and its status as the most diverse plant group.

Plants also respond to changes in their environment during their lifetime and between generations as adaptations to their environment.

Students should investigate aspects of plant tropisms and adaptations that allow plants respond to their changing environment and maintain homeostasis. In some cases plant adaptations permit survival in extreme environments or weather conditions e.g extreme cold or heat, extreme wet or dry environments, in fresh or salt water (refer to Unit 1, and the effect of hypo and hypertonic solutions on cells) or on high energy tidal shores.

Teaching Suggestions

A discussion of angiosperms as the most diverse plant group could include the mention of: the assistance from animals and wind in pollination, the presence of structures in plants specific to attracting certain animal pollinators which the plants supply with food, the way seeds are protected by unique structures, and the function of fruits in seed dispersal.

Biology 111 Teaching Suggestions

Students can explore the unique physiological processes of C4 plants and CAM plants pertaining to their adaptations to climate e.g. cacti, pineapple, sedums.

A More Detailed Look at Plants con't

Tasks for Instruction and/or Assessment

Laboratory activities (316-6, 213-8, 214-1, 214-3)

Plant dissection labs could include a look at the structures of a variety of plant types from mosses to ferns to gymnosperms and angiosperms, a comparison of vascular and non-vascular structures, a comparison of reproductive structures - flower and/or seed types, female and male gymnosperm cones, and pollen grains. For many of these structures students will need to use their microscope skills.

Presentation (116-7, 215-2, 317-1, 317-8)
Select a plant that survives in what may be considered an inhospitable environment or simply an environment very different from the local one, and investigate the homeostatic mechanisms it utilizes to ensure its survival and reproduction. Present your conclusions to the class, and/or prepare a poster or model of the organism labeled in such a manner to illustrate the homeostatic mechanisms involved.

Presentation (215-2, 317-8)
Research and select a type of tropism of interest to you. Include details of the tropism, its advantages, and evolution. Be prepared to make a brief presentation to the class on your selection.

Biology 111
Laboratory Activities (116-7, 212-6, 213-5, 214-9, 214-10, 214-15, 215-2, 215-4, 317-1, 317-8)
Experimental Design
Within your group, develop a research question and design an appropriate experiment to investigate it. Suggested topics may include:

- Tropisms (thigmo-, hydro-, gravi-, chemo-, phototropism)
- Transpiration and how it affects temperature and water loss
- The effect of growth hormones on plants
- The effect of flooding or salt water on root cells
- Adaptations of plants to extreme conditions

Carrying out the Experiment
You will be assessed on how well you follow the design, use correct and safe techniques, and if necessary how you redesign your experiment.
Presentation
Following the completion of your experiment, you will be required to compile and organize your data in a clear and concise format, and discuss as a group what conclusions can be made. Be prepared to present your data and conclusions to the class, and to explain why your group made certain decisions in planning and conducting your experiment.

As a group, summarize the experiment in a written lab report, including sections for an introduction, purpose and hypothesis, results and data, and discussion (see Appendix 2).

Notes

Appendix 1 – Biodiversity Chart at the end of this document.

PH Biology
Plants: pp.550-572, pp. 612-613, 639-646, 633-638

"Problem Solving" p.553
"Focus on the Big Idea" p.555, 642
"Writing in Science" p.559
"Thinking Visually" p.563, 572, 646
"Quick Lab" p.565, 613, 640
"Sharpen your Skills" p.568
"Exploration" p.573
"Real World Lab" p.648

cbe-7222/ cbp-7222, cbn-7221, cbd-7222, cbn-7224, cbn-7223, cbe-7252/ cbp-7252, , cbb-7225, cbe-7249/ cbp-7241

Lab Manual A
p.171, .177, 183, 189, 207

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A More Detailed Look at Animals

(12 hours)

NB Prescribed Outcomes

It is expected that students will:

Elaborations

The intention of this section is to survey a selection of animal phyla, with a focus on adaptations to a variety of environments.

While progressing through the various phyla of the animal kingdom the development of the digestive, excretory, circulatory, and respiratory systems of representative organisms should be highlighted. This should be linked back to Unit 1 and the requirements of each cell for nutrition, excretion, and oxygen. This will also support the study of the human systems in Unit 3, and the study of evolutionary theory and human systems in grade 12 Biology.

For both invertebrates and chordates, students should be given an opportunity to trace the evolutionary development of various systems and characteristics, and how development of various systems has allowed exploitation of other habitats. By identifying the ancestors which may or may not still be found, they can explore the evidence that supports various lineages. (e.g Tiktaalik fossil found in Ellesmere Island, Canada).

- Describe the differences that exist between the invertebrate phyla with respect to symmetry, body cavity, reproduction and digestion. (316-4, 316-5, 316-6)

Selected phyla of invertebrates should be examined to illustrate evolutionary trends and the differences in symmetry, body cavity, circulation, respiration, digestion, and reproduction, and embryonic development (protostome / deuterostome).

- Describe characteristics that have contributed to the success of arthropods in a wide variety of environments.

Students should focus on arthropods and on insects in particular, as the biologically most varied and numerous class of animals.

- Describe the differences and similarities that exist between the classes of chordates. (116-7, 214-1, 316-5, 316-6, 317-1)

General characteristics and developmental trends of various representative systems should be explored in non-vertebrate chordates, and in the vertebrates - fishes, amphibians, reptiles, birds and mammals.

In this section students should be given an opportunity to view live and/or preserved specimens, and should carry out one or two dissections, and understand the role that dissections play in scientific inquiry.

A More Detailed Look at Animals con't

Tasks for Instruction and/or Assessment

Laboratory activities (316-6, 213-8, 214-1, 214-3)

Animal dissection labs could include the squid, earthworm, grasshopper, and frog, giving attention to various systems and how, for a given species, these reflect the environment for which that species is adapted.

Notes

Appendix 1 – Biodiversity Chart This chart found at the end of this document.

PH Biology
pp. 744-758, 715-719, 725-733, 766-770, 848-864

"Problem Solving" p.750
"Quick Lab" p.753, 718, 775, 861
"Thinking Visually" p.758, 856
"Design an Experiment" p.759, 211, 739,
"Focus on the Big Idea" p.719, 852
"Sharpen your Skills" p.725
"Writing in Science" p.731, 733, 770, 864
"Analyzing Data" p.855
"Exploration" p.790, 865
"Issues in Biology" p. 853

Lab Manual A
p.201, 237
Lab manual B
p..181

cbe-8299/ cbp-8291, cbn-8292, cbn-8281, cbn-9301, cbn-9331, cbn-9332, cbe-9333/ cbp-9333, cbb-9333

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Biodiversity within Ecosystems

(5 hours)

NB Prescribed Outcomes

It is expected that students will:

- Explain how biodiversity of New Brunswick ecosystems is related to their sustainability. (318-6)
- Compare New Brunswick eco-regions in terms of biodiversity, climate, physical geography, and location. (318-7)
- Analyze the impact of human behaviour, and human population growth on biodiversity and ecosystems. (331-6, 318-10)

Elaborations

Throughout this unit students have been exploring the range of species in our ecosystems. The intention of this section is take this study of biodiversity to a deeper level – to investigate why biodiversity is important, how it is threatened, and what steps we can take to maintain or restore it.

As students explore the importance of biodiversity, it will be important to realize that issues around biodiversity and ecosystem sustainability affect, not just people in the tropics or in developing countries, but all of us, including citizens of New Brunswick.

Students should identify the unique species, climate and geology of New Brunswick's ecosystems. They should recognize the diversity and interdependence of organisms within each ecosystem and the how they contribute to maintaining dynamic equilibrium.

Students should compare biodiversity in New Brunswick and elsewhere by reviewing the many threats that are often driven by human population pressures and/or lack of knowledge or the will to prevent losses. Threats to biodiversity include habitat loss, introduced species, overexploitation, disruption of ecosystems, and the isolation of small population.

Teaching Suggestions

Discussions of values of intact functioning ecosystems might include support of human health and populations as a source of food, medicine, clothing, energy, shelter, and reserves for the future, maintenance of water quality, flood and drought control, healthy soil, climate moderation, pollution absorption, and waste processing.

Biodiversity within Ecosystems con't

Tasks for Instruction and/or Assessment

Paper & Pencil
Select one of the New Brunswick protected natural areas, and research the biodiversity which makes it unique from the perspective of its biotic and abiotic features and the rare or at risk species that are found within that ecosystem. Discuss the reasons for maintaining protected natural areas, the different levels of protection, and what values are considered when managing these areas. Present as a poster, essay, or an electronic presentation.

Laboratory Activities (116-7, 214-5, 214-8, 318-7)
Select an appropriate local area to use for a scientific field study. Collect, tabulate and graph data as instructed on the biotic elements (plant and animal species) and selected abiotic factors (air/soil temperature, wind velocity, precipitation amounts, humidity, chemical analysis of soil/water) evident in your field study area. Collect both qualitative and quantitative data as it is appropriate.

Include a discussion on the relevance, reliability and adequacy of your data and data collection techniques.

Assess students based on completeness and the accuracy of information and the selection of a method for data presentation.

Paper & Pencil (215-3, 318-7)
Research and prepare a class presentation on a New Brunswick ecoregion using electronic and library research skills. Prepare a handout for class members to facilitate their recording of the pertinent features of your ecoregion during your presentation. Be sure to include information on climate, vegetation, geography and location, and any other features that make your ecoregion interesting and distinct.
Assessment can be twofold – including the information presented by the individuals or groups and on the efficiency with which class members complete the distributed chart.

Notes

PH Biology *pp.150-156, 138-149*
"Quick Lab" p. 153
"Writing in Science" p.155, 149
"Focus on the Big Idea" p 156
"You and Your Community" p.143

Lab Manual B*, pp.187-191*
cbn-2063, cbn-2061, cbe-2069/ cbp-2062

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

BIOLOGY 11

UNIT 3 – Maintaining Dynamic Equilibrium I

Introduction

Cells, tissues, organs, organ systems and ultimately organisms must maintain a biological balance despite changing external conditions. Homeostasis is the state of internal balance on which existence depends. It represents a dynamic equilibrium displaying constant interactions and checks and balances both within organisms, between organisms and with their environment. There are a variety of systems within living things responsible for the maintenance of this delicate balance and this unit will identify and introduce the role of those plant and animal systems including the circulatory, respiratory, digestive, excretory and immune systems. The vital links that exist between them will be investigated.

Curriculum Focus

This unit has its primary focus within the area of decision-making (STSE) as social and environmental issues are considered. This STSE component contributes to the development of scientific literacy and a sense of global citizenship. In addition, there are numerous opportunities for problem-solving and scientific inquiry incorporated into the discussion of the circulatory, respiratory, digestive, excretory and immune systems.

Curriculum Links

Biology students have studied the components of body systems at a number of different levels. Students in Grade 2 are introduced to the importance of maintaining a healthy lifestyle. When they reach the level of Grade 5 they begin to discuss the role of specific body systems in growth and reproduction. The major components of the structure and functions of the digestive, excretory, respiratory, circulatory and nervous systems are introduced. The contributions of the skeletal, muscular and nervous system to movement are also integrated into their study. In addition, body defenses against infection and nutritional requirements to promote health are discussed. When students reach the level of Grade 8, they begin to consider the basic factors that effect the functioning and efficiency of the human respiratory, circulatory, digestive, excretory and nervous systems and are encouraged to discover and describe examples of the interdependence of various systems of the human body. These provide a good introduction to the role of systems in the maintenance of homeostasis discussed in more detail here. A cross-curricular link exists between the life sciences and physical sciences in the discussion of dynamic equilibrium incorporated into APEF Chemistry and Physic**s.**

Unit 3 – Maintaining Dynamic Equilibrium 1
Pan- Canadian Specific Curriculum Outcomes

STSE (Science, Technology, Society and Environment)

Nature of Science & Technology.
114-4 Identify various constraints that result in tradeoffs during the development and improvements of technologies.

115-5 Analyse why and how a particular technology was developed and improved over time.

Relationships between Science & Technology
116-4 Analyse and describe examples where technologies were developed based on scientific understanding.

116-7 Analyse natural and technological systems to interpret and explain their structure and dynamics.

Social & Environmental Contexts of Science & Technology.
117-2 Analyse society's influence on scientific and technological endeavours.

117-4 Debate the merits of funding specific scientific or technological endeavours and not others.

118-6 Construct arguments to support a decision or judgment, using examples and evidence while recognizing various perspectives.

118-8 Distinguish between questions that can be answered by science and those that cannot, and between problems that can be solved by technology and those that cannot.

118-9 propose a course of action on social issues related to science and technology, taking into account human and environmental needs.

118-10 Propose courses of action on social issues related to science and technology, taking into account an array of perspectives, including that of sustainability.

SKILLS

Initiating and Planning
212-6 Design an experiment and identify specific variables.

Performing & Recording
213-5 Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data.

213-9 Demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials.

Analysing & Interpreting
214-9 Identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information.

214-10 Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty.

214-15 Propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan.

Communication & Teamwork
215-2 Select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results.

215-4 Identify multiple perspectives that influence a science-related decision or issue.

KNOWLEDGE

314-1 Identify chemical elements and compounds that are commonly found in living systems.

314-2 Identify the role of some compounds, such as water and glucose, commonly found in living systems.

314-3 Identify and describe the structure and function of important biochemical compounds, including carbohydrates, proteins and lipids.

317-1 Explain how different plant and animal systems, including the vascular and nervous systems, help maintain homeostasis**.**

317-3 Explain the importance of nutrition and fitness to the maintenance of homeostasis.

317-4 Identify, in general terms the impact of viral, bacterial, genetic and environmental diseases on the homeostasis of an organism.

317-6 Predict the impact of environmental factors such as allergens on homeostasis within an organism.

317-8 Explain how behaviours such as tropisms, instinct, and learned behaviour help to maintain homeostasis.

Homeostasis

(2 hours)

NB Prescribed Outcomes

It is expected that students will:

Elaborations

In this section, students should be given the opportunity to study a variety of factors that affect the homeostasis of an organism. Through this, they will begin to appreciate the complexity of mechanisms involved in the maintenance of homeostasis.

- Explain what is meant by the concept of homeostasis and its critical nature to living things. (317-1, 317-8)

Students should be able to explain, with examples, the concept of homeostasis in general terms.

- Using humans as an example, explore ways that behaviours and systems respond to changes in the external environment. (317-1, 317-6, 317-8)

Students should consider this topic with reference to human systems. Discussions with and among students should include various scenarios in which a person's external environment or behaviour modifies the internal environment, and in response the body activates feed-back mechanisms that result in regaining homeostasis.

Teaching Suggestions

In the study of homeostasis in Human systems examples could include:
Body temperature - what is the response to raised body temperature (on a hot day or when exercising for example) or lowered body temperature?
Water and salt levels - what is the response to loss of water and salt through excessive sweating?
Muscle use - what is the response to aerobic exercise such as running?

Homeostasis con't

Tasks for Instruction and/or Assessment

Paper & Pencil (317-1, 317-3, 317-6, 317-8)
Consider what happens to your body when you are frightened. Prepare a concept map to illustrate the interaction between the reactions produced and the body systems involved in the maintenance of homeostasis.

Notes

PH Biology *pp.890-896*

"Thinking Visually" p.896

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Digestive system – *the chemistry of nutrition*

(5 hours)

NB Prescribed Outcomes

It is expected that students will:

- Identify and describe the structure and function of carbohydrates, protein, lipids and nucleic acids and where they are found in living organisms. (314-1, 314-2, 314-3)

Elaborations

Students should describe the basic structure of carbohydrates, lipids, proteins and nucleic acids, and how, through digestive processes these can be broken down to smaller molecules such as glucose, fatty acids, and amino acids.

Discussion of these molecules should include their role in energy release, growth, repair, and communication between cells. Links should be made to cell structure and functioning, and respiration in Unit 1 – the breakdown of glucose in respiration, the protein and lipid structure of cell membranes, burning of fats and protein when carbohydrates are not available.

Students should investigate the presence and energy value of carbohydrates, lipids and proteins, in a variety of the foods that are commonly consumed.

A laboratory exercise should be provided to determine either:
The presence of carbohydrates, lipids and proteins in various foods
OR The calorimetric content of various foods.

- Explain the importance of nutrition and fitness to the maintenance of homeostasis. (317-3)

Students should recognize the importance of good nutrition and fitness to homeostasis and good health. Besides carbohydrates, lipids and proteins, the importance of other nutrients such as water, vitamins and minerals should be emphasized, in the maintenance of homeostasis. The consequences of nutrient imbalances and deficiencies should also be explored. Links should be made to Canada's food guide.

- Describe eating and digestive disorders and their effect on the homeostasis of the system and the organism as a whole. (116-7, 317-1, 317-3, 317-4)

Students should describe the eating disorders bulimia and anorexia, and digestive disorders such ulcers, gall stones, ileitis, colitis, cancer, Crohn's disease, celiac disease, and the ways to diagnose, treat or cure these problems.

Teaching Suggestions

Students should research, and prepare a report or presentation on the issue of whether society and public health care should be held responsible for the cost of treatment of health problems caused primarily by correctable lifestyles?

Digestive system – the chemistry of nutrition con't

Tasks for Instruction and/or Assessment

Presentations (317-1)
Extend an invitation to community resources such as physicians, organizations (Ileitis and Colitis Association, Canadian Liver Association) or sufferers of eating disorders (anorexia nervosa) to speak to the class.
Research and prepare questions related to the topic being presented by the guest speaker. Working in groups, these questions should be reviewed and revised, and questions selected to be asked during the presentation. Following this presentation, you may be asked to prepare a brief summary of it, or of the answer to your question.
Assessment may be based on a student summary of the guest's talk or answers provided to one of their questions.

Laboratory Activities (213-5, 214-10, 215-2, 317-1)
Perform a lab activity to:
- detect the presence within food of organic substances such as carbohydrates, lipids and proteins
- determine the energy value in found in carbohydrate or lipid food materials.

Record and display data comparing food categories.

Paper and Pencil
Student food journals over a period of time can be used to see how the guide relates at a personal level.

Research Topics and Presentations (117-2, 118-8, 118-10, 215-4)
- Research and evaluate how nutritional deficiencies caused by fad diets (e.g. high protein, high carbohydrate, low fat) starvation diets, or eating disorders e.g. bulimia and anorexia nervosa) can adversely affect the equilibrium of other body systems.

- Many individuals routinely consume various vitamins, minerals and herbal supplements in their search for a healthy lifestyle. Research and investigate the origins of and the claims made by manufacturers of these herbal medicines (e.g., Echinacea, St. John's Wort, Gingko biloba, garlic, etc.) and any scientific basis or data that exists for these assumptions.

- **S**urgical approaches to deal with the problems of obesity, and their potential health effects.

- Dietary restrictions such as lactose or gluten intolerance - investigate its prevalence, causes, and methods employed to control the symptoms.

Notes

PH Biology *pp.44-48, 970-977*
"Design an Experiment" pp.990
"Quick Lab" p.982
Lab Manual B *pp.243-246*

"Analyzing Data" p.977
"Exploration" p.1025

cbe-1024, cbe-0381

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Digestive System – *the process of digestion and excretion*

(7 hours)

NB Prescribed Outcomes

It is expected that students will:

- Describe the structures, purpose and functioning of the digestive system. (116-7, 317-1)
- Identify the major glands of digestion, their secretions and their role in the digestive process. (116-7, 317-1)
- Describe the main structures of the human urinary system, including the kidney, ureter, bladder, urethra and nephrons. (116-7, 317-1)
- Explain the role of the kidney as an excretory organ in removing metabolic wastes from the body and excreting them to the environment, and the impact of kidney failure. (114-4, 115-5, 116-7, 213-5, 317-1)
- Perform an experiment to investigate the effect of specified variables on the effectiveness of an enzyme. (212-6, 213-5, 213-9)

Biology 111

- Design an experiment to investigate the effect of specified variables on the effectiveness of an enzyme. (212-6, 213-5, 213-9)
- Describe the internal structure of the kidney and explain the function of a nephron. (116-7, 317-1)

Elaborations

Students should be provided with the opportunity to study the principal features and action of the human digestive tract, including the mucous lining, villi, sphincters and peristalsis activities and to trace the pathway of food through the digestive system using models, computer simulations and/or dissections of mammals.

Students should identify the main glands of digestion, including alivary glands, stomach, liver, pancreas and the small intestine , and their secretions including mucus, acids or bases, and enzymes, and describe the role of each of these secretions in the digestion of carbohydrates, lipids and proteins. Students should be able to define and give examples of mechanical and chemical digestion as food moves through the digestive system.

Students should recognize the kidney's structure as including the cortex, medulla and pelvis, and should be able to describe the filtration and re-absorption functions of the nephron. Students should be provided with the opportunity to observe and identify the principal features of the human urinary system using drawings, photographs, models, computer simulations and/or performing dissections.

Students should recognize the critical role that the excretory system plays in maintaining homeostasis with respect to water, salt and metabolite concentrations within the blood.

Students should explore the impacts of kidney failure that may result from a variety of conditions and can lead to many deleterious effects including abnormal concentrations of salt and water, altered pH and general deterioration of homeostasis.

Students should perform laboratory activities to investigate the efficacy of various digestive enzymes on animal and/or plant tissue under a variety of concentrations, pH levels, and temperatures.

Teaching Suggestions

Students could perform experiments to investigate simulated urine composition, perform data analysis and summarize the role of the kidney in homeostatic regulation of pH, water and ionic substances.

Biology 111 Elaborations

Students should take an active part in designing and reporting on laboratory experiments investigating enzyme action.

Students should describe the structure of the nephron and recognize its role as the working unit of the kidney.

Biology 111 Teaching Suggestions

Students could research work done at the University of Alberta to investigate islets of langerhans transplants as a potential cure for Diabetes.

Digestive System – the process of digestion and excretion con't

Tasks for Instruction and/or Assessment

Laboratory Activities (212-6, 213-5, 214-10, 215-2, 317-1)
Perform the available lab activities that illustrate some aspects of the digestive system.
- Tests for the action of digestive enzymes on animal or plant tissue.
- Dissection of available specimens to observe the systems of digestion.

Design an experiment to investigate the relative effectiveness of commercially advertised antacid products.

Presentations (117-4, 317-1)
Expose students to experts of excretory pathologies by using community resources such as physicians, organizations (Kidney Foundation), sufferers of these disorders, dialysis patients, and transplant recipients.
Research and prepare questions related to the topic being presented by the guest speaker. Working in groups, these questions should be reviewed and revised, and questions selected to be asked during the presentation. Following this presentation, you may be asked to prepare a brief summary of it, or of the answer to your question.
Assessment may be based on a student summary of the guest's talk or answers provided to one of their questions.

Biology 111

Laboratory Activities (212-6, 213-5, 214-10, 215-2, 317-1)
Design an experiment to determine the optimal temperature, pH, or concentration for the activity of a given enzyme and submit it for approval. Carry out the experiment with a final report in mind that you will have to hand in, in which the following sections will need to be included –introduction with a hypothesis, material and methods, data and results, discussion and conclusions.

Perform the lab activities provided to illustrate some aspects of the excretory system. These may include:
- Microscopic examination of a kidney cortex.
- Investigations using simulated urine.
- Dissection of available specimens to observe the systems of excretion.
- Observation of the contractile vacuole in Paramecium.

Assessment would depend on the nature and depth of the activities selected. Enrichment may be provided by allowing students the opportunity to design their own investigations from questions that these activities may generate.

Presentations (114-4, 115-5, 116-4, 117-2, 117-4, 118-8, 118-10)
You will be assigned to a group and given directions to research a topic in preparation for a debate. The format of this debate will require you to display the results of your research and "argue" against other stakeholders concerning issues such as:
- Selection procedure for organ transplant recipients.
- Ethics of the sale of human organs (developing countries).
- Ethics of organ transplants across species.

Assessment may be based on the participation of selected students, preparation of the argument, thoroughness of the research and/or a written summary.

Notes

PH Biology *pp. 49-55, 978-984, 985-989*
"Analyzing Data" p.51
"Design an Experiment" pp.54

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Circulatory and Respiratory System

(8 hours)

NB Prescribed Outcomes

It is expected that students will:

- Explain the function of the human circulatory and respiratory systems and how they interact. (116-7, 317-1)
- Trace the flow of blood through the heart, describe the pulmonary and systemic pathways, and follow the flow through the complete cycle. (116-7, 317-1)
- Describe the structure and function of an artery, a vein and a capillary. (116-7, 317-1)
- Identify and explain the role of leucocytes, erythrocytes, platelets, and plasma. (116-7, 317-1)
- Investigate the structures and mechanics of respiratory system. (116-7, 212-6, 215-2, 213-5, 317-1)
- Design and carry out an experiment to investigate blood pressure, respiratory function or cardiac output under various conditions. (212-6, 213-5, 214-9, 214-10, 215-2, 317-3)
- Describe disorders linked to the circulatory system and/or the respiratory system and their effect on the homeostasis of the system and the organism as a whole. (317-1, 317-3, 317-4, 317-6)

Biology 111

- Describe adaptive features that provide for efficient gas exchange in humans (116-7, 317-1)

Biology 111 Optional

- Predict the impact of environmental factors such as allergens on homeostasis within an organism. (317-6)

Elaborations

Students should explain how the circulatory system both delivers materials and disposes of cellular wastes, and helps maintain equilibrium by transporting gases, heat, energy and matter.

Students should be given the opportunity to observe and identify the structures of the circulatory and respiratory systems through drawings, photographs, use of models, computer simulations and/or doing dissections.

Students should be able to track the pathways of blood through the circulatory system and relate this to the transport of gases (O_2 and CO_2) through the respiratory system. A study of the heart should include identifying the relationship between heart mechanics and the sounds of a heartbeat, making note of the Foramen ovale between the right and left atrium during birth, and gaining an appreciation of how the direction of blood flow is controlled.

Students should identify differences in the physical structure of an artery, vein and capillary, and should be able to relate each structure to their functions in the circulation of blood.

The specific pathologies of the circulatory system created by circulatory disorders (hypertension and atherosclerosis, varicose veins, heart murmur, aneurysm, blood clots, and leukemia), and/or by respiratory disorders (lung cancer, asthma, and pneumonia) could be discussed or researched along with the capability of technology to diagnose, treat or cure the problem.

Students may research, assess and debate the effect that lifestyle choices play in the development of these disorders and the importance of promoting good nutrition, physical fitness, control of stress levels and good health in general.

Teaching Suggestions

Students may construct a model to illustrate the functioning of the diaphragm in respiration. A popular design involves the use of a bell jar, balloons to represent lungs and a membrane for the diaphragm.

Biology 111
Elaborations

Students should describe the structures of the respiratory system that increase gas exchange including: *cilia, mucous membranes, large surface area of alveoli, cartilaginous rings in airway, epiglottis.*

Biology 111 Optional - Elaboration and Teaching suggestions

Environmental factors that can impact on respiratory disorders such as asthma, bronchitis, or emphysema may include cigarette smoke, allergens (dust, mold, food), petrochemical fumes, smog and perfumes.

Students can investigate air quality indices, what they measure and the units used, and obtain local records of these over time which can then be graphed, or presented in tabular form. Students can hypothesize reasons for varying air quality indices correlation with weather, environmental events) and the effects on an individual with respiratory difficulties when these indices are high

Circulatory and Respiratory System con't

Tasks for Instruction and/or Assessment

Laboratory Activities (212-6, 213-5, 214-9, 214-10, 215-2, 317-1)

1) Design and/or perform experiments on the circulatory and respiratory system investigating:

- a student's own blood pressure (systolic and diastolic) and posture, or exercise
- lung volume and vital capacity using a spirometer*
- breathing rates at different times of rest or activity.
- carbon dioxide content of exhaled air.
- respiration, blood pressure or pulse rate of students, and smoking or fitness level
- respiration of asthmatics before and after using an inhaler
- respiration, blood pressure, or pulse rate with gender or weight

**A device called a spirometer- used by patients recovering from surgery – can be used to measure lung capacity. Information on operating a spirometer, or ways to build a homemade spriometer can be found on the internet.*

2) Perform lab activities such as:

- Microscopic examination of components of the blood and the structure of blood vessels.
- Measurement of blood pressure and heart rates.
- Dissection of available specimens to observe the heart and circulatory systems or to observe respiratory systems.
- Measurement of carbon dioxide concentration in inhaled or exhaled air.
- Development of a model illustrating the effect of the diaphragm.

Assessment would depend on the nature and depth of the activities selected. Many of these activities involve collection of data that can be tabulated and graphed.

Teachers should ensure that students are aware that interpretation of statistical data from small sample sizes may not reflect the true nature of the general population.

Presentations (114-4, 115-5, 116-4, 117-2, 117-4, 118-8, 118-10, 215-4)

In debate format display the results of research and "argue" against other stakeholders concerning:

- Should smoking be allowed in public places?
- Should tobacco companies be permitted to sponsor sporting events?
- Should tobacco advertising be permitted?
- In some provinces, young people cannot purchase cigarettes until the age of 19, yet it is not illegal to smoke at a younger age. Is this hypocritical?
- Should schools provide their students with a smoking area?

Sectors of society that will be considered may include lung cancer victims, executives from tobacco companies, students, smokers, clean air activists.

Assess the participation of selected students, preparation of the argument and thoroughness of the research.

Presentations (117-4, 317-1)

Expose students to experts in circulatory pathologies by using community resources such as physicians, organizations (Heart and Stroke Foundation), sufferers of these disorders or transplant recipients.

Research and prepare questions related to the topic being presented by the guest speaker. Working in groups, these questions should be reviewed and revised, and questions selected to be asked during the presentation. Following this presentation, you may be asked to prepare a brief summary of it, or of the answer to your question.

Assessment may be based on a student summary of the guest's answers to one of their questions.

Notes

***PH Biology** pp.942-955, 956-965, 1044*
"Writing in Science" p.949, 950
"Analyzing data" p.954
"Quick Lab" p.960
"Design an experiment" p.964

Lab manual A p.261
Lab manual B p. 239

cbe-0373, cbe-0371
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Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Immune System

(7 hours)

NB Prescribed Outcomes

It is expected that students will:

Elaborations

Students should be aware that a properly functioning immune system is essential for health and well being and recognize the consequences that result when the immune system does not function properly.

- In general, explain how the immune system recognizes and destroys antigens that penetrate the first line of defense. (116-7, 317-1, 317-4, 317-6)

A study of the immune system should include non-specific first line defenses (such as skin, sweat and stomach acids), and further defenses including the inflammatory response, phagocytes, T cells, B cells and antibody production.

- Compare the mechanisms of various forms of acquired immunity. (314-3, 317-1)

Students should explore and compare the ways in which immunity is acquired, both in passive (e.g. breast milk) and active (e.g. exposure, vaccines) ways.

- Explain the meaning of the terms allergen and antibody and their role in an allergic reaction. (317-4, 317-6)

Students should be aware of the sequence of the general physiological events (or symptoms) that result in an allergic reaction, and the role of histamines in causing this reaction. Students should be able to describe how allergic responses affect the maintenance of homeostasis within an organism.

- Describe various autoimmune diseases, their causes, and possible treatments. (317-4)

The general definition of an autoimmune disease should be established and then the specifics of various diseases explored – this should include Type 1 diabetes, rheumatoid arthritis, myasthenia gravis, and multiple sclerosis, and acquired immune deficiency syndrome (AIDS), combined immune deficiency.

Students should explore the reason for the emergent of viral infections worldwide especially relating to animal vectors (SARS, avian flu) .

- Explore the political and economic issues around the worldwide AIDS epidemic. (118-6, 118-9)

Students should explore the issues surrounding the World AIDS epidemic through research, a debate or class discussion and/or a written opinion piece.

Teaching suggestions

A visual display (chart or sketch) of the role of each of these factors in the body's defense system may help students grasp the basics of these concepts. This discussion may be expanded to include the role of the lymphatic system within the immune response.

Students could investigate:

- how vaccines make use of the immune system in order to be effective
- the requirements, interest and financial resources of society to support the prevention of the spread of HIV, *Staphylococcus*, smallpox
- the claim that herbal supplements such as *Echinacea* boost the immune system.
- a comparison between respiratory allergies such as hay fever and food allergies, how and why some allergies are severe enough to be life threatening
- the use and effectiveness of over the counter antihistamine, decongestants and allergy shots to control allergies.

Immune System con't

Tasks for Instruction and/or Assessment

Presentations (115-5, 116-4, 116-7, 317-1, 317-4, 317-6)
Investigate the natural response of the body to a bacterial infection or a viral disease such as a cold or the flu and present your findings to the class *(this can be linked to the study of viruses and bacteria in the biodiversity unit).*

Investigate the mechanism of transplant rejection or a selected autoimmune disease (rheumatoid arthritis, myasthenia gravis, multiple sclerosis, rheumatic fever, systemic lupus erythematosus ('lupus'), thyroiditis) and how this results in the symptoms of the disorder. Present your findings to the class.

Assessment will be based on thoroughness and accuracy of information. Instead of a presentation results could be passed in for written assessment.

Laboratory Activities (212-6, 317-1, 317-6)
Suggest a hypothesis and design an experiment to investigate one of the following, or a topic of your choice to be submitted for approval.

- Investigate the antimicrobial nature of substances such as mouthwash and extracts from a variety of plants (garlic, ginger, aloe).
- Compare the effectiveness of soaps or other cleaning products labeled anti-bacterial with those of the same brand that are not labeled as such.

Present your results (213-5, 214-9, 214-10, 215-2, 317-1, 317-6)
Compile and organize your data using appropriate formats (numeric tables, graphs) and present your data and conclusions in class. Be prepared to explain why you made certain decisions in planning and conducting the experiments.

Performance (213-5, 214-9, 214-10, 215-2, 317-1, 317-6)
Once the experiments have been designed and the design approved, students can be assessed on how well they follow the design, use correct and safe techniques, and troubleshoot as required.

Paper & Pencil
(213-5, 214-9, 214-10, 214-15, 215-2, 317-1, 317-6)
Prepare and conduct a survey of the prevalence and variety of allergies within the school population and the remedies used to alleviate symptoms. Tabulate data and prepare it in an appropriate format for a bulletin board display for the school population.
Assessment would be based on the survey questions, the sampling technique, and the effective presentation of the results.

Presentations (215-4, 317-1, 317-3)
Select an herbal supplement or vitamin and investigate its effect on the functioning of the immune system. Prepare a poster for display. Be sure to include both natural and synthetic sources of these products.

Notes

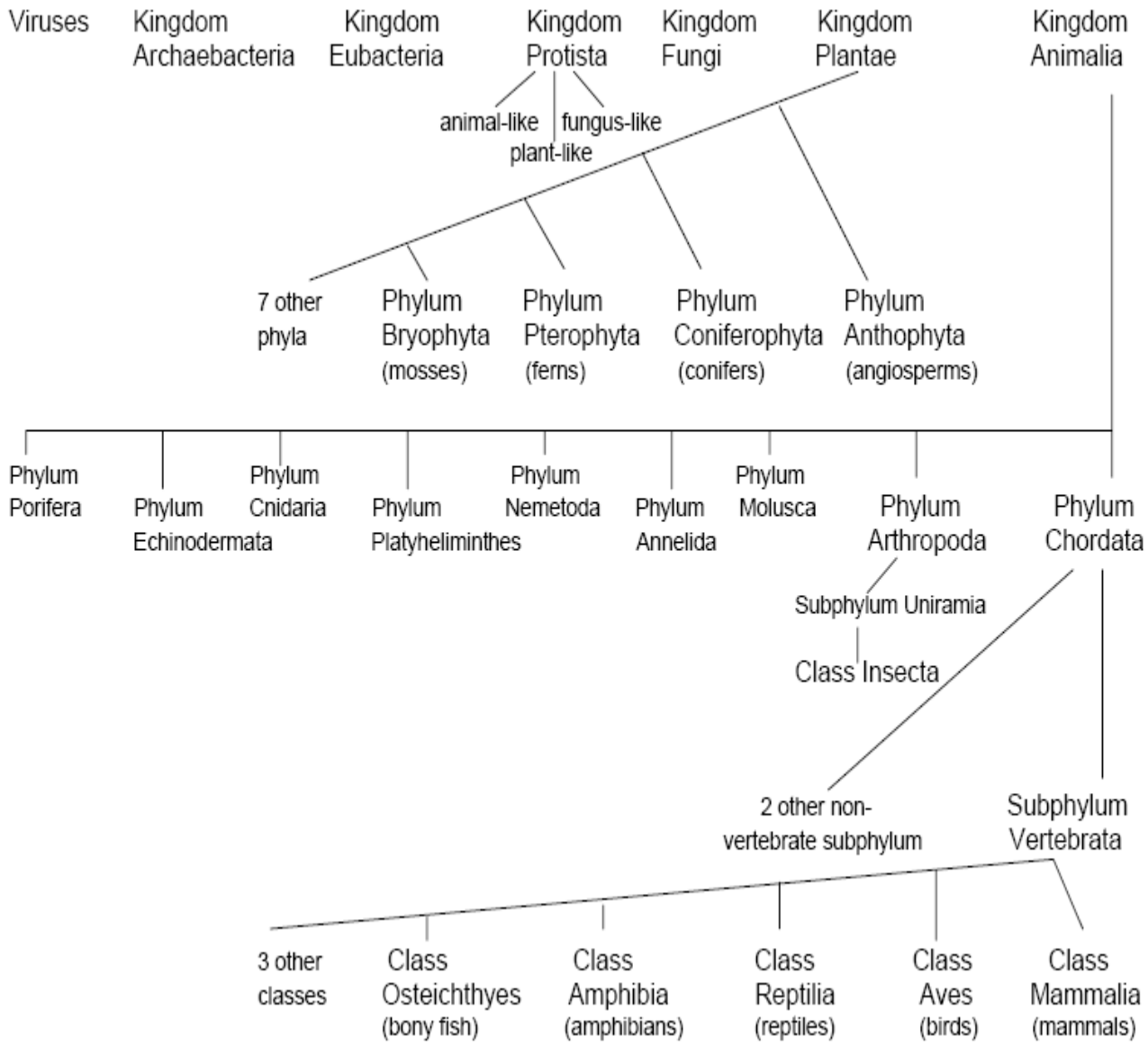
PH Biology *pp.1030-1047*

"Real World Lab" p.1055

Lab Manual B*, pp. 253-56*

Check NB Government Portal for current links and shared resources
https://portal.nbed.nb.ca/

Appendix A - Biodiversity Chart



Appendix B - Formal Laboratory Write-up

A laboratory report should communicate, as clearly and concisely as possible (in third person, past tense), the purpose of the experiment, what was done, what the results were and what they mean. From the laboratory report a reader should be able to repeat the experiment or procedure and get similar results. The report should be as short and simple as possible to accomplish these ends.

The format suggested below is one way to accomplish the objectives given above. However, another format may be preferred or may be more appropriate for certain experiments. Your grade on the reports will depend on completeness, scientific accuracy and insight, organization, and writing skills.

Title Page or Heading

This should include a title which describes the lab, your and your partner's name, the class section, teacher and date.

Abstract

This is a brief summary of the lab. It should state the purpose of the experiment, the techniques used, the results, and the conclusions. (4-7 sentences)

Introduction

The introduction will begin with the background context for the experiment, or what is known prior to the experiment. This could include how it is related to the work done in class, and any outside research you have done in preparation for the lab. This will be followed by a brief description of the ideas behind and the purpose of the experiment, and the hypothesis you will be testing. (2-5 paragraphs)

Materials and Methods

This section will describe the equipment and materials you used and what you did, clearly and detailed enough so that others will be able to repeat the experiment without any outside help.

List the apparatus in paragraph format (i.e. scissors, burner stand, 2 clamps etc.). A diagram will be needed if the apparatus is set up in a specific way for the lab. If a diagram is needed, it should be done on unlined paper, and titled, labeled and placed as an appendix at the end of the report.

Describe the procedures you followed to get your results. Include details on controls, variables measured, and how and at what time intervals measurements were taken. Think of your reader as another student who has not done the experiment. You should demonstrate clearly that you know and understand what you did and can articulate it simply.

Data & Results

In this section you will summarize but will not interpret the data collected - raw data should be placed in an appendix. Data should be summarized, statistically analyzed, and presented in a concise format such as a table, graph or chart, clearly labeled with titles, legends and scale. If questions on the lab are assigned they can also be included in this section.

Discussion and Conclusions

In this section you will interpret and discuss the significance of the results and explain how your results either support or refute your hypothesis. Discuss ways in which your results might be useful, and possible directions for future research.

State possible explanations for unexpected results, and draw conclusions based on the results. If problems were encountered during the course of the experiment, how might they be rectified in the future? Are there any other things that could be done to make this a better experiment or to more specifically address the initial question posed? Are there any better techniques available that would allow one to more accurately generate data? Is there more than one way to explain the results? Your results may support your initial hypothesis, but there may be more than one conclusion that could be drawn from your results.

Remarks (optional)

Critique the experiment as presented. Could the lab be done in a better way? Do you have some other or original method for obtaining the same results? Your suggestions are encouraged!

References (optional)

If you referred to anything you read, it should be listed in this section.

e.g. Articles from Journals:

Marmur, J. 1961. A procedure for the isolation of deoxyribonucleic acid from microorganisms. *J. Mol. Biol.* 3:208-218.

e.g. Articles in Books:

Rose and D.W. Tempest (ed.), *Advances in Microbial Physiology*, Vol. 16. Academic Press, London and New York.