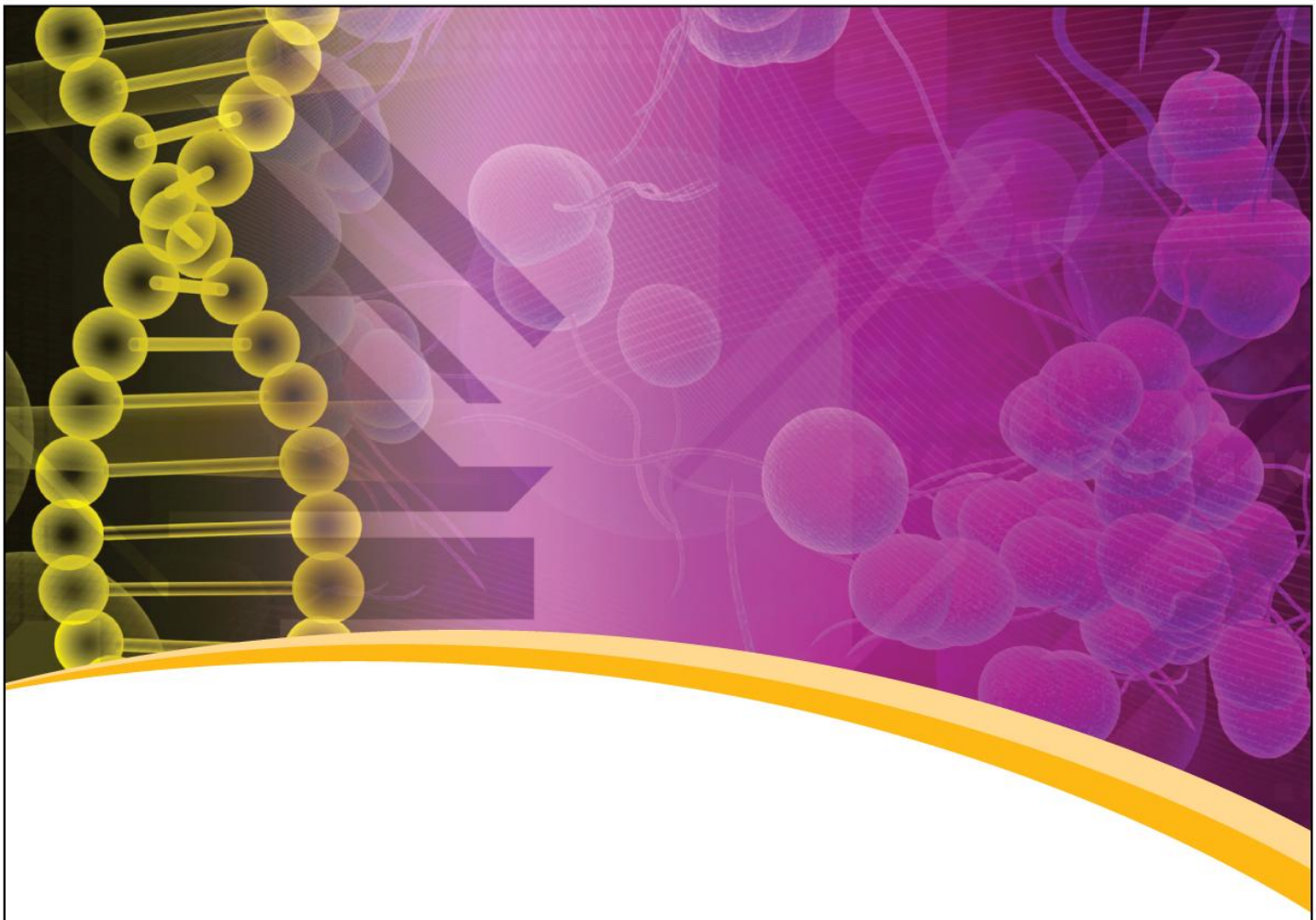

# Biology 121-122
# Curriculum

Implemented September 2008

New Nouveau Brunswick

*New Brunswick Department of Education*

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

*June 2008*

*Document # 844310*

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| | |
|---|---|
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# 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**

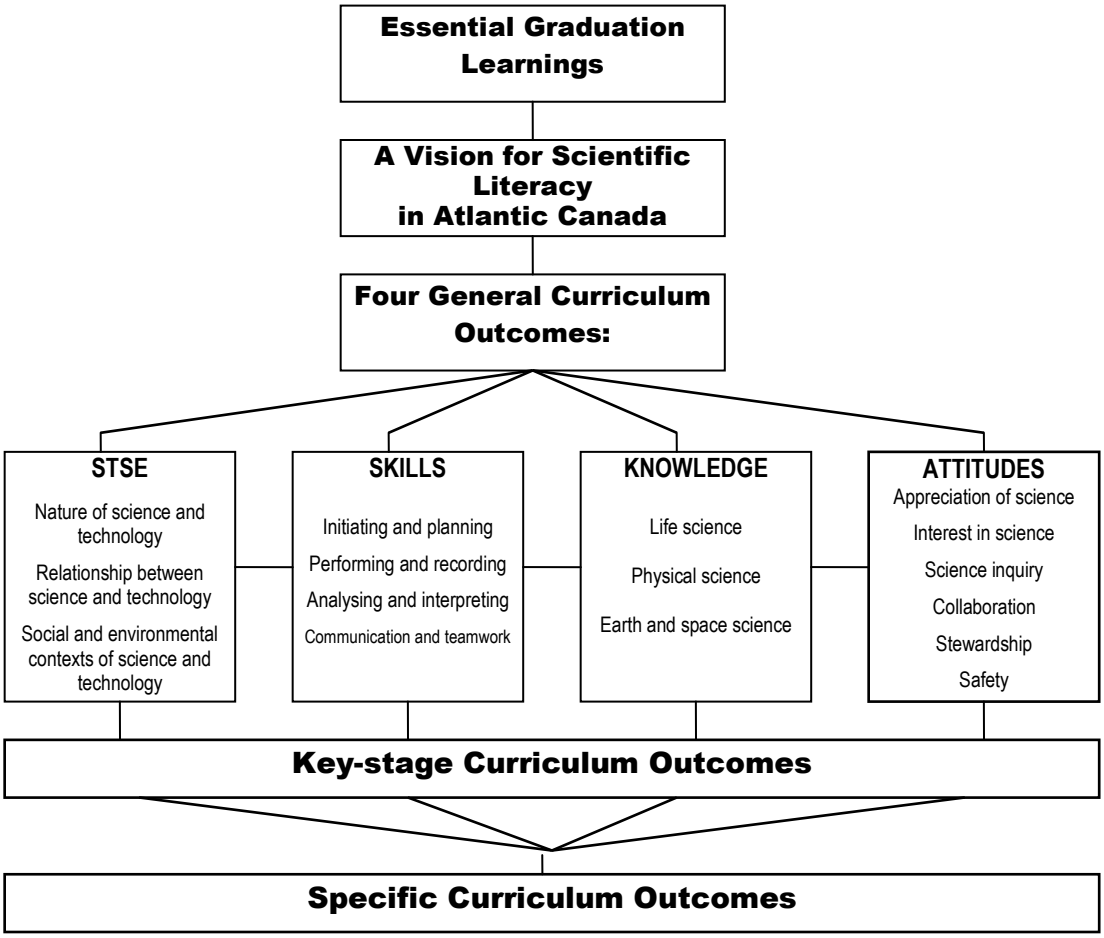
- gather information from a variety of sources
- evaluate the validity of the information source
- evaluate which information is relevant
- identify the different perspectives that influence a decision
- present information in a balanced manner
- use information to support a given perspective
- recommend 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<br>• Additional outcomes for Level 1 course<br>• Optional outcomes to be completed after completion of above outcomes | Elaborations of outcomes listed in column one<br><br>Teaching Suggestions | Informal/Formal Observation<br><br>Performance<br><br>Journal<br><br>Interview<br>Paper and Pencil<br>Presentation<br>Portfolio | References to prescribed text and supporting resources.<br><br>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<br><br>***Evident when students, for example,***<br><br>– give examples of science in their own lives<br><br>– give examples of how objects studied and investigations done in class relate to the outside world<br><br>– 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<br>402 willingly observe, question, and explore<br><br>***Evident when students, for example,***<br><br>– ask "why" and "how" questions about observable events<br>– ask many questions related to what is being studied<br>– participate in show-and-tell activities, bringing objects from home or sharing a story or an observation<br>– ask questions about what scientists do<br>– express enjoyment from being read to from science books<br>– seek out additional information from library books and digital discs<br>– express enjoyment in sharing science-related information gathered from a variety of sources, including discussions with family members and friends<br>– ask to use additional science equipment to observe objects in more detail<br>– express the desire to find answers by exploring and conducting simple experiments | 403 consider their observations and their own ideas when drawing a conclusion<br>404 appreciate the importance of accuracy<br>405 be open-minded in their explorations<br><br>***Evident when students, for example,***<br><br>– raise questions about the world around them<br>– willingly record observations in a given format<br>– compare results of an experiment with other classmates<br>– use observations to draw a conclusion or verify a prediction<br>– take the time to measure with care<br>– willingly explore a change and its effects<br>– choose to follow directions when they complete a simple investigation<br>– 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<br><br>***Evident when students, for example***,<br><br>– willingly share ideas and materials<br>– respond positively to others' questions and ideas<br>– take on and fulfil a variety of roles within the group<br>– participate in science-related activities with others, regardless of their age or their physical or cultural characteristics<br>– 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<br><br>***Evident when students, for example,***<br><br>– ensure that living things are returned to an adequate environment after a study is completed<br>– demonstrate awareness of the need for recycling and willingness to take action in this regard<br>– show concern for other students' feelings or needs<br>– care for living things that are kept in their classroom<br>– clean reusable materials and store them in a safe place<br>– 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<br><br>***Evident when students, for example***,<br><br>– are attentive to the safe use of materials<br>– insist that classmates use materials safely<br>– act with caution in touching or smelling unfamiliar materials, refrain from tasting them, and encourage others to be cautious<br>– point out to others simple and familiar safety symbols<br>– put materials back where they belong<br>– follow given directions for set-up, use, and clean-up of materials<br>– wash hands before and after using materials, as directed by teacher<br>– seek assistance immediately for any first aid concerns like cuts, burns, and unusual reactions<br>– 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<br>410 realize that the applications of science and technology can have both intended and unintended effects<br>411 recognize that women and men of any cultural background can contribute equally to science<br><br>***Evident when students, for example,***<br><br>– recognize that scientific ideas help explain how and why things happen<br>– recognize that science cannot answer all questions<br>– use science inquiry and problem-solving strategies when given a question to answer or a problem to solve<br>– plan their actions to take into account or limit possible negative and unintended effects<br>– are sensitive to the impact their behaviour has on others and the environment when taking part in activities<br>– show respect for people working in science, regardless of their gender, their physical and cultural characteristics, or their views of the world<br>– encourage their peers to pursue science-related activities and interests | 412 show interest and curiosity about objects and events within different environments<br>413 willingly observe, question, explore, and investigate<br>414 show interest in the activities of individuals working in scientific and technological fields<br><br>***Evident when students, for example,***<br><br>– attempt to answer their own questions through trial and careful observation<br>– express enjoyment in sharing and discussing with classmates science-related information<br>– ask questions about what scientists in specific fields do<br>– express enjoyment in reading science books and magazines<br>– willingly express their personal way of viewing the world<br>– demonstrate confidence in their ability to do science<br>– pursue a science-related hobby<br>– 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<br><br>416 appreciate the importance of accuracy and honesty<br><br>417 demonstrate perseverance and a desire to understand<br><br>***Evident when students, for example***,<br><br>–ask questions to clarify their understanding<br>– respond constructively to the questions posed by other students<br>– listen attentively to the ideas of other students and consider trying out suggestions other than their own<br>– listen to, recognize, and consider differing opinions<br>– open-mindedly consider non-traditional approaches to science<br>– seek additional information before making a decision<br>– base conclusions on evidence rather than preconceived ideas or hunches<br>– report and record what is observed, not what they think ought to be or what they believe the teacher expects<br>– willingly consider changing actions and opinions when presented with new information or evidence<br>– record accurately what they have seen or measured when collecting evidence<br>– take the time to repeat a measurement or observation for confirmation or greater precision<br>– ask questions about what would happen in an experiment if one variable were changed<br>– 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<br><br>***Evident when students, for example,***<br><br>– participate in and complete group activities or projects<br>– willingly participate in cooperative problem solving<br>– stay with members of the group during the entire work period<br>– willingly contribute to the group activity or project<br>– willingly work with others, regardless of their age, their gender or their physical or cultural characteristics<br>– 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<br><br>***Evident when students, for example,***<br><br>– choose to have a positive effect on other people and the world around them<br>– frequently and thoughtfully review the effects and consequences of their actions<br>– demonstrate willingness to change behaviour to protect the environment<br>– respect alternative views of the world<br>– consider cause and effect relationships that exist in environmental issues<br>– recognize that responding to their wants and needs may negatively affect the environment<br>– choose to contribute to the sustainability of their community through individual positive actions<br>– 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<br>421 become aware of potential dangers<br><br>***Evident when students, for example,***<br><br>– look for labels on materials and seek help in interpreting them<br>– ensure that all steps of a procedure or all instructions given are followed<br>– repeatedly use safe techniques when transporting materials<br>– seek counsel of the teacher before disposing of any materials<br>– willingly wear proper safety attire, when necessary<br>– recognize their responsibility for problems caused by inadequate attention to safety procedures<br>– stay within their own work area during an activity, to minimize distractions and accidents<br>– immediately advise the teacher of spills, breaks, or unusual occurrences<br>– share in cleaning duties after an activity<br>– seek assistance immediately for any first aid concerns like cuts, burns, and unusual reactions<br>– 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<br>423 appreciate that the applications of science and technology can have advantages and disadvantages<br>424 appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds<br><br>***Evident when students, for example,***<br><br>– recognize the potential conflicts of differing points of view on specific science-related issues<br>– consider more than one factor or perspective when formulating conclusions, solving problems, or making decisions on STSE issues<br>– recognize the usefulness of mathematical and problem-solving skills in the development of a new technology<br>– recognize the importance of drawing a parallel between social progress and the contributions of science and technology<br>– establish the relevance of the development of information technologies and science to human needs<br>– recognize that science cannot answer all questions<br>– consider scientific and technological perspectives on an issue<br>– identify advantages and disadvantages of technology<br>– seek information from a variety of disciplines in their study<br>– avoid stereotyping scientists<br>– 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<br>426 confidently pursue further investigations and readings<br>427 consider many career possibilities in science- and technology-related fields<br><br>***Evident when students, for example,***<br><br>– attempt at home to repeat or extend a science activity done at school<br>– actively participate in co-curricular and extra-curricular activities such as science fairs, science clubs, or science and technology challenges<br>– choose to study topics that draw on research from different science and technology fields<br>– pursue a science-related hobby<br>– discuss with others the information presented in a science show or on the Internet<br>– attempt to obtain information from a variety of sources<br>– express a degree of satisfaction at understanding science concepts or resources that are challenging<br>– express interest in conducting science investigations of their own design<br>– choose to investigate situations or topics that they find challenging<br>– express interest in science- and technology-related careers<br>– discuss the benefits of science and technology studies | 428 consider observations and ideas from a variety of sources during investigations and before drawing conclusions<br>429 value accuracy, precision, and honesty<br>430 persist in seeking answers to difficult questions and solutions to difficult problems<br><br>***Evident when students, for example,***<br><br>– ask questions to clarify meaning or confirm their understanding<br>– strive to assess a problem or situation accurately by careful analysis of evidence gathered<br>– propose options and compare them before making decisions or taking action<br>– honestly evaluate a complete set of data based on direct observation<br>– critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion<br>– critically consider ideas and perceptions, recognizing that the obvious is not always right<br>– honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results<br>– take the time to gather evidence accurately and use instruments carefully<br>– willingly repeat measurements or observations to increase the precision of evidence<br>– choose to consider a situation from different perspectives<br>– identify biased or inaccurate interpretations<br>– report the limitations of their designs<br>– respond skeptically to a proposal until evidence is offered to support it<br>– seek a second opinion before making a decision<br>– 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<br><br>***Evident when students, for example,***<br>– assume responsibility for their share of the work to be done<br>– willingly work with new individuals regardless of their age, their gender, or their physical or cultural characteristics<br>– accept various roles within a group, including that of leadership<br>– help motivate others<br>– consider alternative ideas and interpretations suggested by members of the group<br>– listen to the points of view of others<br>– recognize that others have a right to their points of view<br>– choose a variety of strategies, such as active listening, paraphrasing, and questioning, in order to understand others' points of view<br>– seek consensus before making decisions<br>– advocate the peaceful resolution of disagreements<br>– can disagree with others and still work in a collaborative manner<br>– are interested and involved in decision making that requires full-group participation<br>– share the responsibility for carrying out decisions<br>– 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<br>433 project, beyond the personal, consequences of proposed actions<br><br>***Evident when students, for example,***<br>– show respect for all forms of life<br>– consider both the immediate and long-term effects of their actions<br>– assume personal responsibility for their impact on the environment<br>– modify their behaviour in light of an issue related to conservation and protection of the environment<br>– consider the cause-and-effect relationships of personal actions and decisions<br>– objectively identify potential conflicts between responding to human wants and needs and protecting the environment<br>– consider the points of view of others on a science-related environmental issue<br>– consider the needs of other peoples and the precariousness of the environment when making decisions and taking action<br>– insist that issues be discussed using a bias-balanced approach<br>– participate in school or community projects that address STSE issues | 434 show concern for safety in planning, carrying out, and reviewing activities<br>435 become aware of the consequences of their actions<br><br>***Evident when students, for example,***<br>– read the labels on materials before using them, and ask for help if safety symbols are not clear or understood<br>– readily alter a procedure to ensure the safety of members of the group<br>– select safe methods and tools for collecting evidence and solving problems<br>– listen attentively to and follow safety procedures explained by the teacher or other leader<br>– carefully manipulate materials, using skills learned in class or elsewhere<br>– ensure the proper disposal of materials<br>– immediately respond to reminders about the use of safety precautions<br>– willingly wear proper safety attire without having to be reminded<br>– assume responsibility for their involvement in a breach of safety or waste disposal procedures<br>– stay within their own work area during an activity, respecting others' space, materials, and work<br>– take the time to organize their work area so that accidents can be prevented<br>– immediately advise the teacher of spills, breaks, and unusual occurrences, and use appropriate techniques, procedures, and materials to clean up<br>– clean their work area during and after an activity<br>– seek assistance immediately for any first aid concerns like burns, cuts, or unusual reactions<br>– 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<br>437 appreciate that the applications of science and technology can raise ethical dilemmas<br>438 value the contributions to scientific and technological development made by women and men from many societies and cultural backgrounds<br><br>***Evident when students, for example,***<br><br>– consider the social and cultural contexts in which a theory developed<br>– 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<br>– recognize the usefulness of being skilled in mathematics and problem solving<br>– recognize how scientific problem solving and the development of new technologies are related<br>– recognize the contribution of science and technology to the progress of civilizations<br>– carefully research and openly discuss ethical dilemmas associated with the applications of science and technology<br>– show support for the development of information technologies and science as they relate to human needs<br>– recognize that western approaches to science are not the only ways of viewing the universe<br>– consider the research of both men and women | 439 show a continuing and more informed curiosity and interest in science and science-related issues<br>440 acquire, with interest and confidence, additional science knowledge and skills, using a variety of resources and methods, including formal research<br>441 consider further studies and careers in science- and technology-related fields<br><br>***Evident when students, for example,***<br><br>– conduct research to answer their own questions<br>– recognize that part-time jobs require science- and technology-related knowledge and skills<br>– maintain interest in or pursue further studies in science<br>– recognize the importance of making connections between various science disciplines<br>– explore and use a variety of methods and resources to increase their own knowledge and skills<br>– are interested in science and technology topics not directly related to their formal studies<br>– explore where further science- and technology-related studies can be pursued<br>– are critical and constructive when considering new theories and techniques<br>– use scientific vocabulary and principles in everyday discussions<br>– readily investigate STSE issues | 442 confidently evaluate evidence and consider alternative perspectives, ideas, and explanations<br>443 use factual information and rational explanations when analysing and evaluating<br>444 value the processes for drawing conclusions<br><br>***Evident when students, for example,***<br><br>– insist on evidence before accepting a new idea or explanation<br>– ask questions and conduct research to confirm and extend their understanding<br>– criticize arguments based on the faulty, incomplete, or misleading use of numbers<br>– recognize the importance of reviewing the basic assumptions from which a line of inquiry has arisen<br>– expend the effort and time needed to make valid inferences<br>– critically evaluate inferences and conclusions, cognizant of the many variables involved in experimentation<br>– critically assess their opinion of the value of science and its applications<br>– criticize arguments in which evidence, explanations, or positions do not reflect the diversity of perspectives that exist<br>– insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position taken can be judged<br>– 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<br><br>***Evident when students, for example,***<br><br>– willingly work with any classmate or group of individuals regardless of their age, gender, or physical and cultural characteristics<br>– assume a variety of roles within a group, as required<br>– accept responsibility for any task that helps the group complete an activity<br>– give the same attention and energy to the group's product as they would to a personal assignment<br>– are attentive when others speak<br>– are capable of suspending personal views when evaluating suggestions made by a group<br>– seek the points of view of others and consider diverse perspectives<br>– accept constructive criticism when sharing their ideas or points of view<br>– criticize the ideas of their peers without criticizing the persons<br>– evaluate the ideas of others objectively<br>– encourage the use of procedures that enable everyone, regardless of gender or cultural background, to participate in decision making<br>– contribute to peaceful conflict resolution<br>– encourage the use of a variety of communication strategies during group work<br>– 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<br>447 project the personal, social, and environmental consequences of proposed action<br>448 want to take action for maintaining a sustainable environment<br><br>***Evident when students, for example,***<br><br>– willingly evaluate the impact of their own choices or the choices scientists make when they carry out an investigation<br>– assume part of the collective responsibility for the impact of humans on the environment<br>– participate in civic activities related to the preservation and judicious use of the environment and its resources<br>– encourage their peers or members of their community to participate in a project related to sustainability<br>– consider all perspectives when addressing issues, weighing scientific, technological, and ecological factors<br>– participate in social and political systems that influence environmental policy in their community<br>– examine/recognize both the positive and negative effects on human beings and society of environmental changes caused by nature and by humans<br>– willingly promote actions that are not injurious to the environment<br>– make personal decisions based on a feeling of responsibility toward less privileged parts of the global community and toward future generations<br>– 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<br>450 be aware of the direct and indirect consequences of their actions<br><br>***Evident when students, for example***,<br><br>– read the label on materials before using them, interpret the WHMIS symbols, and consult a reference document if safety symbols are not understood<br>– criticize a procedure, a design, or materials that are not safe or that could have a negative impact on the environment<br>– consider safety a positive limiting factor in scientific and technological endeavours<br>– carefully manipulate materials, cognizant of the risks and potential consequences of their actions<br>– write into a laboratory procedure safety and waste-disposal concerns<br>– evaluate the long-term impact of safety and waste disposal on the environment and the quality of life of living organisms<br>– use safety and waste disposal as criteria for evaluating an experiment<br>– 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<br>– seek assistance immediately for any first aid concerns like cuts, burns, or unusual reactions<br>– keep the work station uncluttered, with only appropriate lab materials present |

*New Brunswick Department of Education*

# *Daily Teaching Guide*

# ***Biology 12***

***(levels 1 and 2)***

*June 2008*

*Document # 844300*

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| | |
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# Table of Contents

**BIOLOGY 11/12 OVERVIEW**

**T**he 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 the earth's ecosystems. They also study some of the systems which allow multicellular organisms to maintain equilibrium as they interact with the outside environment.

In Biology 12, students take the next step and 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 living things at the species and population level. They also add to what they learned in grade 11 by studying more systems that allow multicellular organisms to maintain equilibrium internally and with their environment.

In both grade eleven and twelve, students investigate the impact of biology and technology on society and the impact of human activities on the natural world. A suggested teaching and learning sequence is presented but can be altered as preferred by the teacher.

## BIOLOGY 12 Quick Start Guide

In the Biology 12 program the complexity and continuity of life is demonstrated through the molecular basis of heredity, adaptation and regulation.

Unit 1: Genetic Continuity *(45 hours)*

In this unit students investigate both mitosis in which cells are copied, and meiosis in which gametes are produced. The role of DNA is explored as a template for ongoing protein synthesis and for reproduction. Mendelian genetics, inheritance of traits and the impact of mutations are all explored.

1. Mitosis and cellular reproduction – review the molecular structure of carbohydrates, proteins, lipids and nucleic acids. Describe the cell cycle - growth, chromosome replication, mitosis and cytokineses. Explore regulation of cell growth and the relationship to cancer. *(7 hours)*
2. Meiosis and production of gametes – study the events of meiosis, and the opportunity for variation with crossing over and non-disjunction. Identify a variety of karyotypes and consider ethics with reference to diagnosis of chromosomal abnormalities. *(3 hours)*
3. DNA structure and replication – investigate the historical context of the discovery and understanding of the gene. Study the structure and replication of DNA. *(8 hours)*
4. Gene Expression: Protein synthesis and genetic mutation – study the structure and role of DNA and RNA in protein synthesis, and the causes and consequences of genetic mutation. *(7 hours)*
5. Mendelian Genetics – demonstrate an understanding of complete, incomplete and co-dominance, segregation and independent assortment, monohybrid and dihybrid crosses. Use probability to predict outcomes of genetic crosses. *(5 hours)*
6. Inheritance – investigate inheritance of various traits and how their expression can be influenced by environmental factors. *(5 hours)*
7. Genetic Engineering/ Human Genomics – study the techniques used in genetic engineering, research and debate the risks, concerns and benefits to people and the natural environment. Research and discuss the significance, benefits and ethical issues surrounding the Human Genome project, and other Human DNA analysis. *(10 hours)*

Unit 2: Evolution, Change and Diversity *(10 hours)*
Diversity and variation are investigated as a reflection of the theory of evolution and its mechanism of natural selection.

1. Evolutionary Theory – describe historical and cultural contexts that have influenced the development of evolutionary theory, explain the theory, its significance, and the terminology used. *(5 hours)*
2. Mechanisms and Patterns of Evolution – describe how genes can change and subsequently impact on survival and reproduction, thereby becoming a mechanism for natural selection. Explore various patterns of evolution seen over time. *(5 hours)*

Unit 3: Maintaining Dynamic Equilibrium (II) *(35 hours)*
In this unit students investigate the role of electrochemical and chemical systems in the regulation of homeostasis, the structure and functioning of those systems and the impact of disease and medical technology on the organism. They then study how the changes involved in reproduction and development are regulated and accommodated internally, and consider some of the ethical considerations surrounding reproductive technology.

Nervous and Endocrine System
*(20 hours)*

1. Neuron structure and function – explore the role of the nervous system in maintaining homeostasis, and study the structure and operation of the neuron as it transfers impulses. *(10 hours)*
2. Central and peripheral systems – study the structure and functions of the central and peripheral nervous systems, and nervous system disorders. *(3 hours)*
3. Glands and hormone action – examine the maintenance of homeostasis by the endocrine system in coordination with the nervous system. Study the concept and operation of hormones and target cells. Locate the major endocrine glands and identify the source and effect of specific hormones on humans. *(3 hours)*
4. Homeostasis and feedback mechanisms – describe positive and negative feedback mechanisms. Describe disorders of the endocrine system and the effect on homeostasis. *(4 hours)*

***Biology 121***

5. The brain, the eye, the ear– the structure and functions of the human brain, eye and ear, the effects of disease, defects, and injuries, and corresponding treatments. Links can be made to wave, sound and light studies in Physics.

Reproductive System *(15 hours)*

1. Male and female reproductive systems –. Describe the structures of sperm and the male reproductive system, and of eggs and the female reproductive system. Describe the role hormones play in development and the menstrual cycle. *(5 hours)*
2. Fertilization, development and childbirth – Describe the process of fertilization, fetal development and childbirth, and the issues around genetic testing, and the effect of alcohol and drug abuse on fetal development. *(7 hours)*
3. Reproductive technologies – Research and evaluate the techniques, risks, effectiveness, and ethical considerations of fertility treatments and contraception. *(3 hours)*

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

| Suggested Time | # hrs. | Text Sections | Text pages | Suggested activities<br>PHSchool.com webCode |
|---|---|---|---|---|
| ***Unit 1 Genetic Continuity - 9 weeks (45 hours)*** | | | | |
| Mitosis and Cellular Reproduction | *7* | *10-2, 10-3* | *pp. 244-252, 1052-1053* | *"Analyzing Data" p.249, 1053*<br>*"Writing in Science" p.249*<br>*"Exploration" pp.254-255*<br>*"Technology and Society" p.253*<br>**cbe-3104, cbp/cbe-3102** |
| Meiosis and the Production of Gametes | *3* | *11-4, 14-1, 14-2, 14-3* | *pp. 275-278 341, 352-3* | *"Writing in Science" p.253*<br>**cbp/cbe-4114** |
| DNA structure and replication | *7* | *12-1, 12-2* | *pp.44-53, 286-299* | *"Exploration" p.313*<br>*"Writing in Science" p.293*<br>**cbp/cbe-4122** |
| Gene Expression: Protein synthesis and genetic mutation | *8* | *12-3, 14-1* | *pp. 300-308, 344-348* | *"Quick Lab" p.303*<br>*"Writing in Science" p.306, 308*<br>*"Thinking Visually" p.348*<br>**cbp/cbe-4123** |
| Mendelian Genetics | *5* | *11-1, 11-2, 11-3, 14-1* | *pp. 262-274, p.344* | *"Thinking Visually" p.266, 269*<br>*"Quick Lab" p.268*<br>*"Problem Solving" p.271*<br>*"Sharpen Your Skills" p.274*<br>**cbp-cbe-4112** |
| Inheritance | *5* | *14-1, 14-2* | *pp. 341-343, 349-352* | *"Problem Solving" p.343*<br>*"Quick Lab" p.351*<br>**cbe/cbp-4141** |
| Genetic Engineering/ Human Genomics | *10* | *13-2, 13-3, 13-4, 14-3* | *pp. 322-333, pp. 355-360* | *"Quick Lab" p.326*<br>*"Writing in Science" p.326, 329*<br>*"Issues in Biology" p.330, 354*<br>*"You and Your Community"p.333*<br>*"Careers in Biology" p.359*<br>*"Real World Lab" p.361*<br>**cbe/cbp-4132** |

| ***Unit 2 Evolution, Change and Diversity - 2 weeks (10 hours)*** | | | | |
|---|---|---|---|---|
| Evolutionary theory | *5* | *15-1, 15-2, 15-3* | *pp. 368-386* | *"Writing in Science" p.375*<br>*"Quick Lab" p.379*<br>*"Exploration" p.387*<br>**cbe/cbp--5153** |
| Mechanisms and patterns of evolution | *5* | *16-1, 16-2, 16-3, 17-4* | *pp. 392-410*<br>*pp. 435-439* | *"Quick Lab" p.401*<br>*"Issues in Biology" p.403*<br>*"Analyzing Data" p.408,438*<br>*"Exploration" p.411, 441*<br>**cbe-5169/ cbn-5162** |

| ***Unit 3 Maintaining Dynamic Ecosystems II*** *(35 hours)* | | | | |
|---|---|---|---|---|
| **Nervous and Endocrine System** | | | | |
| *- neuron structure and function* | *10* | *35-1, 35-2* | *pp. 897-900* | **cbe/cbp-0352** |
| *- central and peripheral nervous systems* | *3* | *35-3, 35-5* | *pp. 901-904*<br>*pp. 910-914* | *"Quick Lab" p.903, 905*<br>*"Analyzing Data" p. 913* |
| *- glands and hormone action* | *3* | *39-139-2, 25-1* | *pp. 996-1008,* | *"Writing in Science" p.1008* |
| *- homeostasis and feedback mechanisms* | *4* | *39-1* | *pp. 1000-1002* | *"Exploration" p.1025* |
| ***Biology 121*** | | | | |
| *- the brain, the eye, the ear* | | *35-3, 35-4* | *pp. 901-903*<br>*pp. 906-909* | *"Real World Lab" p.915*<br>**cbe-0354** |
| **Human Reproduction** | | | | |
| *- the male and female reproductive systems* | *5* | *39-3* | *pp. 1009-1014* | |
| *- fertilization, development and childbirth* | *7* | *39-4* | *pp. 1016-1023* | *"Quick Lab" p.1022* |
| *- reproductive technologies and ethical considerations* | *3* | | *Not covered in text* | |

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 12 course.

Column one identifies all learning outcomes for Biology 122/121. 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 121***" 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 as optional.

Column four, titled "**Notes**", includes references to the prescribed text and 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 12

## *UNIT 1 – Genetic Continuity*

*Introduction*

Much of the structure and function of every living organism is determined by deoxyribonucleic acid (DNA). It is important for a scientifically literate person to understand principles and fundamentals about DNA: what it is; how it works; how and for what purposes humans are manipulating it; and why this major area of scientific and technological endeavor has dramatic implications for humans and planet Earth. This unit will provide the Grade 12 Biology student with the basic information required for the comprehension of genetics.

*Curriculum Focus*

Within this unit on genetic continuity the primary focus is on **problem solving** and **technology**. However, to appreciate the complexity and uniqueness of DNA and how its structure determines protein construction **scientific inquiry** and **observation** are required. With the inclusion of information on biotechnology and associated bioethics, there is also ample opportunity for **decision-making** and **STSE** components.

*Curriculum Links*

Very early in their study of the life sciences students begin to consider the individuality of organisms. Students in Grade 1 are asked to identify variations that make each person and animal unique from each other and their parents. At the Grade 2 level students identify traits that remain constant and those that change as organisms grow and develop. The unit Reproduction in Grade 9 looks at cell division and develops the idea that the nucleus of a cell contains genetic information and determines cellular processes. Grade 11 Biology continues this theme with its discussion of the nucleus as a critical component of cellular structure.

# *Unit 1- Genetic Continuity*
# *Pan-Canadian Specific Curriculum Outcomes*

**STSE (Science, Technology, Society, Environment)**

**Nature of Science & Technology**
**114-2** Explain the role of evidence, theories, and paradigms in the development of scientific knowledge.

**114-7** Compare processes used in science with those used in technology**.**

**115-3** Explain how a major scientific milestone revolutionized thinking in the scientific communities.

**155-5** Analyze why and how a particular technology was developed and improved over time.

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

**116-4** Analyse and describe examples where technologies were developed based on scientific understanding.

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

**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.

**117-7** Identify and describe science and technology-based careers related to the science they are studying.

**118-2** Analyse from a variety of perspectives the risks and benefits to society and the environment of applying scientific knowledge or introducing a particular technology.

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

**SKILLS**
**Initiating & Planning**
**212-3** Design and delimit problems to facilitate investigation.

**212-4** State a prediction and a hypothesis based on available evidence and background information.

**212-8** Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making.

**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.

**213-7** Select and integrate information from various sprint and electronic sources or from several parts of the same source.

**Analyzing & Interpreting**
**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.

**214-12** Explain how data support or refute the hypothesis or prediction.

**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.

**214-18** Identify and evaluate potential applications of findings.

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

**215-5** Develop, present, and defend a position or course of action, based on findings.

**KNOWLEDGE**
**313-2** Describe in detail mitosis and meiosis.

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

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

**315-1** Summarize the main scientific discoveries that lead to the modern concept of the gene.

**315-2** Describe and illustrate the role of chromosomes in the transmission of hereditary information from one cell to another.

**315-3** Demonstrate an understanding of Mendelian genetics, including the concepts of dominance, co-dominance, recessive traits, and independent assortment, and predict the outcome of various genetic crosses.

**315-4** Compare and contrast the structure of DNA and RNA and explain their role in protein synthesis.

**315-5** Explain the current model of DNA replication.

**315-6** Describe factors that may lead to mutations in a cell's genetic information.

**315-7** Predict the effects of mutations on protein synthesis, phenotypes, and heredity.

**315-8** Explain circumstances that lead to genetic disease.

**315-9** Demonstrate an understanding of genetic engineering, using their knowledge of DNA.

**315-10** Explain the importance of the Human Genome Project and summarize its major findings.

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

**317-5** Evaluate, considering ethical issues, the consequences of medical treatments such as radiation therapy, cosmetic surgery, and chemotherapy

.

# Mitosis and Cellular Reproduction

*(6 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Observe, identify and describe the events of the plant and animal cell cycle, including growth, cytokinesis and chromosome behaviour during mitosis. (213-3, 214-9, 215-2, 313-2)
- Explain the role of chromosomes and the importance of maintaining the chromosome number through cellular reproduction. (313-2, 315-2)
- Investigate controls on cell division including physical and molecular cell cycle regulators. (313-2)
- Investigate the link between mitosis and cancer, including links to gene p53. (313-2)
- Research the methods used to treat cancer and evaluate the physiological and ethical consequences of medical treatments such as radiation therapy and chemotherapy. (317-5)

***Optional***

- Propagate rapidly growing plant material and prepare squashes to observe the chromosomes during cell division. (212-3, 212-8, 213-3, 213-5)

***Biology 121***

- Explore the role of cyclin dependent kinases (cdks) in the regulation of cell growth. (313-2)
- Discuss the role of telomerase in preventing telomere shortening and uncontrolled growth of cells in cancer. (313-2)
- Research the use of stem cell technology, its potency and applications, and the ethics of using it in medicine. (317-5)

### Elaborations

Students should be given the opportunity to observe and investigate the stages of the cell cycle and cytokinesis within both plant and animal cells through laboratory or computer simulations, diagrams, photographs, or other technology.

Stages of mitosis should be observed from prepared slides of plant cells (onion root tips) or animal cells (whitefish blastula). Some comparisons between the process of mitosis in plant and animal cells should be demonstrated by careful examination of these prepared slides.

Students should demonstrate a clear understanding of the role that chromosomes play in a living organism, and the importance of maintaining the chromosome number through the process of cellular reproduction (growth of an organism).

Students should evaluate the role of cell division in the development of cancer and how knowledge of this might be applied to limiting cancerous growth in plants and animals.

Students should research the biological basis behind the use and effectiveness of radiation and chemotherapy for the treatment of cancer and evaluate both the positive and negative aspects of these treatments.

***Optional***

Students should propagate fast growing plant tissue (such as onion root tips) and prepare their own slides for viewing by fixing, squashing and staining the fresh tissue.

### Teaching Suggestions

Students could observe chromosomal detail and banding patterns from prepared slides of chromosomes. The common fruit fly, *Drosophila*, with its large chromosomes is useful for this study. Should apparatus and materials be available, students could extract and then prepare, squash and stain slides of salivary gland chromosomes from *Drosophila*.

Students might be asked to identify, sketch, and discuss what is occurring during each of the stages. Use of a video microscope display can assist in illustrating how to distinguish between cells in each of the different stages.

Students could investigate the role of biotechnology in cell growth and the potential it may hold for the regeneration of damaged tissues or parts of organisms.

Students may research some of the alternative methods of the treatment of cancer that are currently being developed, including newer approaches to the chemical treatment of cancer, and the basis upon which they are effective.

# *Mitosis and Cellular Reproduction con't*

## Tasks for Instruction and/or Assessment

Laboratory Activities (212-3, 212-8, 213-3, 215-2, 313-2)
Perform the available laboratory activities to illustrate some aspects of the process of cell division. These may include: examination of prepared microscope slides of chromosomes, preparation of squashes of Drosophila salivary glands or *allium* root tips, examination of prepared microscope slides of animal and plant cell mitosis and cytokinesis, growth of onion root tips and preparation of squashes to observe chromosomes.

*Assessment would depend on the nature and depth of the activities selected, ranging from the development of microscope diagrams, answering of questions, to a more detailed discussion of procedures and results.*
*Enrichment may be provided by allowing students the opportunity to design their own investigations from questions that these activities may generate.*

Paper & Pencil (215-2, 313-2)
*Provide students with sufficient pipe cleaners of two opposing colours (or other appropriate materials) to allow them to construct models of a pair of homologous chromosomes as they proceed through the process of meiosis.*
Using the materials provided, construct models of a pair of homologous chromosomes and follow their progress through the stages of meiosis (reduction-division). Construct one member of the pair from one colour, the second from another. Illustrate an example of crossing over and follow its transmission.
*Assessment is to be based on accuracy of models and completeness of exercise.*

Paper & Pencil (214-15, 317-5)
Research a method for the treatment of cancer that is currently being developed. Examples you may choose from include monoclonal antibodies, immunotherapy using tumor infiltrating lymphocytes, hyperthermia – using heat, cryotherapy - cold, photodynamic therapy - light, or you may choose an alternative treatment as appropriate. Discuss the pros and cons of each method of treatment.

Presentations (213-7, 215-2, 313-2) Invite a guest speaker to talk about the diagnosis, treatment, and recovery from the various types of cancer. Suggestions include a representative from the Canadian Cancer Society, a palliative care nurse, or an oncologist. 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 you may be asked to prepare a brief summary of the presentation, or of the answer to your question.

Paper & Pencil (116-2, 117-4, 212-8, 213-7, 214-18, 215-2, 317-5) Select an aspect of biotechnology related to cell division that is of interest to you (e.g. regeneration of lost limbs) or a type of cancer for which you will study causes, treatments and statistics. Be sure to investigate your topic using more than one source of electronic or print information. You will be required to prepare a written summary and to present your topic to the class.
*Assessment will be based on the accuracy and relevance of the information gathered and completeness of the research based on a written report and class presentation. You may also be evaluated based on your response to questions generated by the class during the discussion.*

### Notes

***PH Biology***
*pp. 244-252, 1052-1053*

*"Analyzing Data" p.249, 1053*
*"Writing in Science" p.249*
*"Exploration" pp.254-255*

**cbp/cbe-3102**

***Biology 121***
*"Technology and Society" p.253*

**cbe-3104**

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

# Meiosis and the Production of Gametes

*(4 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Describe, in detail, the events of meiosis (reduction-division) and cytokinesis. (313-2)
- Explain the necessity of chromosome reduction during the production of sex cells. (313-2)
- Describe and illustrate the role of chromosomes in the transmission of hereditary information from one cell to another. (115-3, 315-2)
- Describe the crossing-over process and explain its role in helping randomize the gene combinations for sex cells. (313-2)
- Analyze and identify normal and abnormal human karyotypes. (313-2, 315-2)
- Describe non-disjunction in human karyotypes and the conditions it may causes such as Down's syndrome, and Turner's syndrome. (313-2, 315-2)

### Elaborations

Students should prepare and interpret models of a variety of human karyotypes, both normal and abnormal.

### Teaching Suggestions

Classroom or laboratory simulations of the processes of meiosis might be useful. Students could use pipe cleaners to simulate chromosomes and follow the process by preparing pipe cleaner models of chromosomes during each stage in meiosis.

Crossing over (chiasma) in meiosis can be illustrated with the above activity if different pipe cleaner colours are available. This provides the student with a visual confirmation of the exchange of genetic information and its effect on randomizing gene combinations within the chromosomes.

### *Biology 121* Teaching Suggestions

Human Karyotyping Activity: Using a prepared kit from Boreal or Wards, use real human cells, locked in a metaphasal state to prepare a real karyotype.

.

## *Meiosis and the Production of Gametes con't*

### Tasks for Instruction and/or Assessment

**Paper & Pencil** (116-2, 117-4, 212-8, 213-7, 214-18, 215-2, 317-5)
Select a reproductive strategy found within the animal or plant kingdom and present the information collected to the class in the form of charts, tables, diagrams, visual animation or any other appropriate format. Use your initiative to find and present unusual or interesting reproductive strategies.
*Assessment to be on accuracy and relevancy of information gathered and completeness of research based upon the quality of the class presentation.*

**Laboratory Activities** (214-18, 215-2, 313-2)
*Provide students with a variety of human karyotypes.*

Pair and arrange the chromosomes in the manner of a karyotype. Analyse the resulting karyotype for any inherent abnormalities and provide a brief written summary about the causes of the abnormality and what its inheritance means to the individual.

*Assessment will be based on the accuracy and completeness of the exercise.*

**Journal** (313-2)
Select a website that contains activities on meiosis and/or mitosis. Perform an activity that interests you and write a brief report, including the web address, activity, and an evaluation of the site.

### Notes

***PH Biology*** *pp. 275-278, 341, 352-3*
*"Writing in Science" p.253*

**cbp/cbe-4114**

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

# DNA Structure and Replication

*(8 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will*:

- Summarize the main scientific discoveries that led to the modern concept of the gene. (114-2, 115-3, 315-1, 315-3)
- Identify and describe the structure and function of nucleic acids. (314-3)
- Describe the Watson and Crick double helix model of DNA. (115-3, 315-1)
- Diagram and explain the process of DNA replication. (315-5)

***Biology 121***

- Explain the following terms and concepts: Okazaki fragments, Helicase, primers, single stranded binding proteins, primase, ligase, leading/lagging strands. (315-4, 315-5)

### Elaborations

Before beginning this topic, review from grade 11, the structure of carbohydrates, proteins, lipids and nucleic acids, and their functions within a cell and a multi-cellular organism; the role of enzymes as protein molecules that regulate all living systems through their function as biological catalysts; the models of enzyme action (lock & key/induced fit), and of the importance of the shape of these molecules to their function.

Students should identify significant historical milestones leading to the modern concept of the gene, and explain how the work of some of the scientists contributed to this understanding. Students should be aware of and be able to explain how knowledge of the structure, function and replication of DNA revolutionized the understanding of heredity.

Students should be able to explain the role of DNA polymerase in DNA replication. Directionality of the strands and the bonding rule of new nucleotides dictate how replication and even transcription (sense and anti-sense) works.

Students should include in their understanding of DNA structure, the anti-parallel directionality and the concepts of 3 prime/5 prime directions.

### Teaching Suggestions

Students can research and produce an historical timeline to illustrate the many significant scientific discoveries and some of the scientists involved in developing the current concept of the gene - from Mendel in the 1800's, to the Human Genome Project in 2000.

Another approach to making historical timelines more meaningful is to relate the time frame to an event that has some relevance to the student.

Students can brainstorm ideas about DNA and discuss their preconceptions, organize their ideas and, based on their current level of understanding, show the interrelationships between them on a concept web.

Students may design and/or construct models of DNA to illustrate the general structure and base arrangement of the molecule.

Students could experimentally extract DNA from bacteria or some other suitable organism. Alternately or in addition to this, they could be asked to design/implement an improvement on the experimental procedure used to extract this DNA.

Students could investigate the rarity of mistakes made during replication of DNA by discussing the role of DNA polymerase and its 'proofreading' mechanism and the influence of DNA repair enzymes.

### *Biology 121* Teaching Suggestions

Lab activity: test catalase as a model of enzyme activity. (See AP Biology lab manual).

## *DNA Structure and Replication con't*

### Tasks for Instruction and/or Assessment

Paper & Pencil (115-3, 315-1)
You will be provided with the name of a scientific investigator and/or an achievement that has contributed historically to the concept of the gene. Prepare a brief summary of the date, names of appropriate individuals and the contributions made on a large index card and present this information to the class. Following this, add your information card to the chronological timeline at the front of the classroom.

*Assessment can be based on the accuracy and completeness of the information collected.*

Laboratory Activities (315-4)
Design and construct a three-dimensional model of a DNA molecule following these structural guidelines:

- Include a **minimum** number of six base pairs.
- Show all possible base pair combinations.
- Make the model self-supporting.
- Include a key for the identification of various components.

*You will be assessed on the accuracy and completeness of your model.*

Laboratory Activities (214-8, 315-4)
Extract DNA experimentally from the source provided following the guidelines given in the laboratory.

*Assessment will be based on the observation of the group activity and the answering of appropriate questions.*

### Notes

***PH Biology** pp.286-299 (for review pp. 44-53)*

*"Exploration" p.313*
*"Writing in Science" p.293*

***cbp/cbe-4122***

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

# Gene Expression: Protein Synthesis and Genetic Mutation

*(7 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will*:

- Compare and contrast the structure of DNA and tRNA, mRNA and rRNA explain their role in protein synthesis. (115-3, 315-4)

- Demonstrate an understanding of the process of protein synthesis through illustrations and explanations. (315-4 )

- Explain what is meant by a gene mutation and predict, in general, the effect on protein synthesis. Describe how a mutation can be a source of genetic variability. (118-2, 315-4, 315-7)

- Describe factors that can lead to mutations, including those that cause genetic diseases. (118-2, 315-2, 315-3, 317-4, 315-6, 315-7, 315-8)

### *Biology 121*

- Explain the following terms and concepts: RNA editing, 5 prime cap and poly A tail, RNA structures, A site and P site, ATP & pepdidyl transferase, Amino-acetyl – tRNA synthetase. (315-4)

- Describe the process of gene regulation in prokaryotes and eukaryotes. (315-2, 315-4)

### Elaborations

Students should demonstrate an understanding of the role of proteins as the link between genes and inheritable traits.

Students should describe, in general, how genetic information is contained in a DNA molecule/chromosome; how each DNA molecule replicates itself during cell division; how information is transcribed into the base sequences of RNA molecules and is finally translated into the sequence of amino acids in cell proteins.

Students should model the effect of gene mutations on translation and protein synthesis.

Students should demonstrate an understanding of how mutations can be beneficial (a source of variation), neutral, or harmful (causing genetic diseases such as cancer, sickle cell anemia, and human thallesemia).

### Teaching Suggestions

Students may perform simulations to demonstrate the replication of DNA and the transcription and translation of its information.

## *Gene Expression: Protein Synthesis and Genetic Mutation con't*

### Tasks for Instruction and/or Assessment

**Paper & Pencil** (118-2, 315-7)
Investigate the effects on the developing human embryo of exposure to a specific environmental influence. The following are suggestions: thalidomide, alcohol (Fetal Alcohol Syndrome), tobacco/tobacco smoke, diethylstilbesterol (DES), radiation, drugs such as cocaine, LSD, marijuana, viruses (Rubella/German measles, HIV), caffeine, antibiotics (streptomycin, acne drugs), *Streptococcus* bacteria
*Assessment will be based on the accuracy and relevance of the information gathered and completeness of the research shown during a class presentation*.

**Laboratory Activities and Presentation** (212-4, 214-12, 215-5, 315-7)
Design an experiment to investigate the effect of influences such as chemicals or radiation (e.g. microwave, ultraviolet) on the germination of seeds.
*Once the experiments have been designed and the design approved, there is opportunity for assessing how students actually perform the activities. Do they follow their design, use correct and safe technique and , troubleshoot as required?*
After you have conducted your experiment, you will be asked to present your data and conclusions to the class. Compile and organize your data using appropriate formats (e.g. numeric tables, graphs). Be prepared to explain decisions you may have made during the course of planning and conducting your experiment.

**Portfolio** (117-7)
Investigate a career of your choice related to this unit on genetics and heredity. Examples may include: biochemist, genetic counselor, laboratory technologist, geneticist, oncologist, etc. Prepare a small poster on the knowledge and skills required in this career.
*Assessment will be based on the quality of the display prepared.*

**Paper & Pencil** (116-4, 116-6, 118-6)
Within assigned groups, you will be asked to research and report to the class on one of the tools or techniques currently available to study genetics. Areas that may be considered include the polymerase chain reaction (PCR) process, DNA 'fingerprinting' and gel electrophoresis, gene probes, recombinant DNA, cloning, genetic markers and gene mapping

### Notes

***PH Biology***
*pp. 300-308, 344-348*

*"Quick Lab" p.303*
*"Writing in Science" p.306, 308*
*"Thinking Visually" p.348*

**cbp/cbe-4123**

***Biology 121***- pp. 309-312

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# Mendelian Genetics

*(5 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Briefly describe the life and work of Gregor Mendel and the beginning of an understanding of the basis of inheritance patterns. (315-3 )
- Demonstrate an understanding of Mendelian genetics, including the concepts of independent assortment, complete dominance, incomplete dominance, codominance. (212-4, 214-5, 214-12,315-2, 315-3)
- Explain the influence of multiple alleles and polygenic traits, plyotropic and epistatic on inheritance patterns. (315-3)
- Explain and illustrate how probability techniques are used to predict the outcome of various genetic crosses. (212-4, 214-5, 214-12, 315-2, 315-3)
- Predict the outcome of monohybrid and dihybrid crosses using genotypic and phenotypic ratios. (315-3 )

### *Biology 121*

- Demonstrate an understanding of polyploidy and its application in biotechnology. (315-3)

### Elaborations

While exploring Mendelian Genetics, students should record their own individual dominance/recessiveness as related to visual/sensory traits. Data on dominant and recessive characteristics found in the class should also be discussed in relation to the prevalence of the population in general.

Blood types are an example of multiple alleles. Skin colour and eye colour are examples of polygenic inheritance where traits are determined by a number of different contributing genes present at different locations and expression depends on the sum of the influences of all of these. Other examples include animal and plant traits selected by breeders for improving livestock and crops, as well as human characteristics such as susceptibility to cardiovascular disease and athletic ability.

Students should solve genetics problems using Punnett squares or the math product rule, that involve a variety of monohybrid and dihybrid genetic crosses, to predict the genotypes, phenotypes and ratios among offspring and/or those of the parental cross.

### Teaching Suggestions

While exploring Mendelian Genetics students can record the incidence of traits such as a widow's peak, dimples, ability to roll tongue, attached/free ear lobe, and the ability/lack of ability to taste PTC for both themselves and others in the class.

Activities can be performed that model the chance formation and pairing of gametes e.g. simulate Mendel's experiments by substituting the tossing of coins for plant characteristics.

Students can investigate visually the phenotypic ratios evident during a laboratory activity using artificially pollinated ears of corn. Genotypes of the parent ears can be determined and the expected phenotypic ratios predicted.

Students may perform, as an independent study or group project, crosses using fast growing plants or the fruit fly *Drosophila* to investigate the inheritance of various characteristics.

Simulations of forensic investigations or murder mysteries involving clues based on genetic traits (blood type, freckles, etc.) and pedigree information that require students to "solve" a crime based on the information provided are an interesting way to enhance student knowledge and interest in genetic analysis.

# *Mendelian Genetics con't*

## Tasks for Instruction and/or Assessment

Laboratory Activities (212-4, 214-8, 315-2, 315-3)
Perform the activities provided that deal with the concept of heredity. Possibilities include: examination of ears of genetic corn, or the performance of crosses of the fruit fly *Drosophila* to investigate the inheritance of particular characteristics.
*Assessment would depend on the nature and depth of the activities selected ranging from the answering of questions to a more detailed discussion of procedures and results.*
*Enrichment may be provided by allowing students the opportunity to design their own investigations from questions that these activities may generate.*

Paper & Pencil (212-4, 214-12, 315-2, 315-3)
Solve the monohybrid and dihybrid genetic questions prepared for you. In each case analyze the data as requested.
*Assessment will be based on the accurate solution to the problems using the appropriate logic and procedures.*
Analyse the genetic clues presented to you in the 'murder mystery' provided and determine the name of the murderer. Write down in point form the logic that you used to come to your conclusion.
Predict the general location or arrangement of genes within a chromosome from the analysis of crossing over data with which you have been provided.

**Journal** (214-5)
Is there a relationship between the number of chromosomes and the mass of a species? Explain.
Is there a relationship between the number of chromosomes and the complexity of the species? Explain.

## Notes

***PH Biology***
*pp. 262-274, p.344*

*"Thinking Visually" p. 266, 269*
*"Quick Lab" p.268*
*"Problem Solving" p.271*
*"Sharpen Your Skills"p.274*

**cbp/cbe-4112, cbe/cbp-4141**

***Check NB Government Portal for current links and shared resources***
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# Inheritance

*(5 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Distinguish between genotypes and phenotypes evident in autosomal and sex-linked inheritance. (315-3)
- Define sex-linkage. (315-3)
- Explain why sex-linked defects are more common in males than females. (315-3)
- Predict the outcome of genetic problems involving sex-linked genes. (212-4, 214-5, 315-2, 315-3, 315-4)
- Discuss the influence of hormonal and environmental factors on gene expression. (212-4, 315-3)
- Draw and interpret the patterns of inheritance shown on pedigree charts. (212-4, 214-5, 315-3)

### Elaborations

Students should be aware that autosomal inheritance typically involves pairs of genes, with gender being irrelevant to gene expression.

Sex-linked inheritance involves pairs of genes on the X chromosome in the female, and a single gene on the X in the male. In this case, gender is important in gene expression, and gender must be considered a part of the phenotype.

Students should be introduced to the concept of the inheritance of certain characteristics (red-green colour blindness, hemophilia, muscular dystrophy) through the sex chromosomes.

Students should solve genetic problems that involve sex-linked defects, predict the genotypes, phenotypes and ratios among offspring, and compare specifically genotypes and phenotypes for males and females.

Students should be aware that environmental factors might cause a change in the expression of some of the genetic information in an organism. (e.g. the effect of temperature on fur colour on Siamese cats, and the effect of temperature on *Drosophila* wing development).

Students should draw and interpret pedigree charts from data on human single and multiple allele inheritance patterns. They should be able to analyze inheritance data and infer the method of inheritance (dominant, recessive, sex-linked).

### Teaching Suggestions

Colour blindness analysis charts are useful in illustrating this sex-linked characteristic.

Students may compare pedigree charts for the inheritance of non sex-linked and sex-linked conditions. The pedigree of the hemophilia within Queen Victoria's bloodline is readily available and serves to provide a biological/historical cross-curricular link.

Student groups may design procedures, collect data and prepare family pedigrees to demonstrate the inheritance of autosomal traits determined by single and multiple alleles, and sex-linked traits.

## *Inheritance con't*

### Tasks for Instruction and/or Assessment

Paper & Pencil (212-4, 214-12, 315-3)
Solve the sex-linked genetics questions prepared for you. In each case analyze the data as requested.
Analyse the pedigree charts provided and determine the mechanism of inheritance. Determine the unknown genotypes and phenotypes for the indicated individuals.
*Assessment is to be on the accurate solution of the problems using appropriate logic and procedures.*

**Laboratory Activities** (315-3)
Human ABO blood type is an example of the expression of multiple alleles. Determine the blood type of the simulated blood sample with which you are provided and list the potential genotypes that would correspond to this type.

**Laboratory Activities** (212-4, 214-8, 214-12, 315-3)
Within the fruit fly *Drosophila*, the vestigial gene produces larger wings in flies bred at $29^0$C. At less than $29^0$C, offspring are produced with smaller wings.

Primrose plants produce red flowers when raised at room temperature ($20^0$C) and white flowers when raised at temperatures greater that $30^0$C.

As an independent project, you may research, design and perform an experiment to demonstrate the effect of environmental factors on inheritance. The scenarios listed above serve as examples. Your experiment must be approved before it is attempted.

**Journal Entry** (118-6)
In journal form, reflect and respond to the following statement.
**True or False:**
**Males are biologically stronger than females .**
Defend your position.

### Notes

***PH Biology***
*pp. 341-343, 349-352*

*"Problem Solving" p.343*
*"Quick Lab" p.351*

**cbe/cbp-4141**

***Check NB Government Portal for current links and shared resources***
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# Genetic Engineering/Human Genomics

*(10 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Explain the importance of human genome research. (315-10)
- Demonstrate an understanding of current genetic engineering techniques, using knowledge of DNA. (114-7, 115-3, 116-4, 116-6, 117-7, 118-2, 315-9)
- Demonstrate an understanding of the use of restriction enzymes within biotechnology and the role of plasmids and bacteria in DNA transfer between cells. (114-7, 115-3,116-4, 116-6, 117-7, 315-9)
- Demonstrate an understanding of genetic modifications found in a variety of organisms either through naturally occurring processes or through intervention by humans. (114-7, 115-3, 116-4, 116-6, 117-2, 118-2, 118-6, 214-8, 215-5, 315-9)
- Analyze from a biological, social, ethical and environmental perspective the risks and benefits involved in the production and use of genetically modified organisms. (114-7, 115-3, 116-4, 116-6, 117-2, 118-2, 118-6, 214-8, 215-5, 315-9)

### *Biology 121*

- Research and demonstrate an in-depth understanding of current technologies in genetic engineering and the ways in which they are applied in various disciplines (e.g. in medicine, forensics and food production). (315-9)
- Find and review two or three topical areas of research in human genomics. (315-9)

### Elaborations

Human Genomics is a rapidly developing field of research, and as such, the technology and applications will constantly be changing. The intention of this section is for the students to investigate current technologies, and areas of research in human genomics, and the implications of this research, particularly as it relates to genetic engineering and medical research.

Students should be aware of the variety of tools and techniques currently available to study genetics, including restriction enzymes, gel electrophoresis, polymerase chain reaction (PCR), recombinant DNA, genetic markers, DNA 'fingerprinting' and gene mapping. It is recommended that students carry out a lab using one or more current technological techniques (e.g. gel electrophoresis).

Students should investigate a current issue in genetic engineering from a biological, social, ethical and environmental perspective.

Students should be aware of some of the current issues under discussion and the technology and science behind it. They should research the current arguments in support or against a given position, and the risks and benefits to society. They should explore the economic, sociological, ethical, and religious implications of the research, and explore their own position on a given issue.

### Teaching Suggestions

The use of restriction enzymes or biological scissors in DNA fingerprinting can be effectively demonstrated using paper activities on forensics and the matching, based on the activity of a specified restriction enzyme, of a DNA sample found at a crime scene with the DNA of specific suspects. Students could perform simulations to demonstrate the use of restriction enzymes in the creation of new DNA sequences (e.g. electrophoresis).

Current issues to investigate could include:
1) scientists' search for naturally occurring genetic deviations in organisms that have resulted in disease resistance or other beneficial features.
2) the production, patenting, use and labeling of genetically modified foods now available (e.g. soy beans/corn, Nuleaf © potato, triploid salmon in NB, Thompson seedless grapes), and the extent to which it pervades the food industry and to which people are aware of its use.
3) the production and use of genetically modified microorganisms (GMO) for drug production, pollution clean-up, environmental monitoring or mining.
4) the ethical and moral issues around cloning of animals.

## *Genetic engineering/Human Genomics con't*

### Tasks for Instruction and/or Assessment

Paper & Pencil (116-4, 116-6, 117-2, 118-2, 118-6, 215-5, 315-9, 315-10)
Prepare a class presentation and written report on an area you have selected within the topic of biotechnology. Internet web sources provide an extensive database for this exercise.

Analyse the simulation of DNA fingerprinting presented to you and determine which suspect was in the vicinity of the crime scene. Write down in point form the logic that you used to come to your conclusion.

**Presentation** (114-7, 116-4, 116-6, 117-2, 118-2, 118-6, 215-5, 315-9, 315-10)
You will be part of a debate in which you will be required to display the results of your research and "argue" against other stakeholders on some issue in biotechnology. You will represent various sectors of society depending on the issues selected. They may include individuals such as: farmer, politician, environmental activist, consumer, doctor, genetic counselor, representative from a developing country.
*Assess the participation of students, preparation of the argument and thoroughness of the research done.*

**Journal** (114-2, 117-2, 118-2, 118-6, 215-5, 315-9, 315-10)

Human genomics is a quickly developing field. Investigate and reflect on a current issue or question and develop, present and defend a position. Some of the issues and questions arising in 2008 include:

1) How, when and why was the Human Genome Project undertaken, and how will it be used?
2) What is the "thrifty gene hypothesis" and what evidence has been used to support or reject it?
3) What is the "sudden death gene" identified in Newfoundland families, what is ARVC5, and how does it affect the heart muscles? What is the treatment for it?
4) What are the breast cancer genes (BRCA1, BRCA2)? How much does it increase a women's chance of getting cancer? What are the implications and what should her response be on identification of the gene?
5) What are the implications of somatic cell gene replacement therapy in the treatment of human genetic disorders.?
6) What might be the implications of gene therapy on germ or sex cells?
7) Should Frank Ogden, better know as "Dr. Tomorrow", be allowed to trademark his DNA to "protect myself and my unique identity"?

Some of the questions students could consider:

- Would you, as an individual, want to know if you will suffer from a disabling disease later in life? Do you have a right to know?
- Do insurance companies have a right to accept/reject you for insurance coverage based on the results of voluntary and confidential genetic testing predicting your future health?

Do prospective employers have a right to know your genetic status?

### Notes

***PH Biology***
*pp. 322-333, 355- 361*

*"Quick Lab" p.326*
*"Writing in Science" p.326, 329*
*"Issues in Biology" p.330, 354*
*"You and Your Community" p. 333*
*"Careers in Biology" p.359*
*"Real World Lab" p.361*

**cbe/cbp-4132**

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# BIOLOGY 12

## *UNIT 2 – Evolution, Change and Diversity*

*Introduction*

Evolution is a concept in biology that links yesterday with today. This unit focuses on the history, importance and mechanisms of the process of evolution and how a change in the DNA blueprint creates new traits that propel evolution. It builds upon what the students have learned about mutations and genetic variability and shows how these can lead to changes in species based upon natural selection. This unit also outlines scientific evidence and arguments pertaining to the origin, development, and diversity of living organisms on Earth.

*Curriculum Focus*

By the consideration of questions generated by students and teachers and the discussion of issues raised, various learning and assessment activities will meet specific curriculum outcomes within this section. The main focus of this unit falls within the realm of **scientific inquiry** and **observation** as it transposes from a historical to modern perspective on the scientific thought and techniques related to evolution, change and diversity.

*Curriculum Links*

The curricular connections for this unit in the grade 12 biology are in the Grade 6 unit called Diversity of Life, and the Grade 11 level called biodiversity. In grade 6 students are asked to compare adaptations of closely related animals that live in different parts of the world and discuss possible reasons for any differences noted. They are then asked to expand their view of this concept by identifying changes that have occurred in animals over the course of time using the fossil record. In grade11 students are asked to consider biodiversity within the context of adaptations to a range of environments over time. These considerations provide a framework upon which further discussions can be built.

## *Unit 2- Evolution, Change and Diversity*
## *Pan-Canadian Specific Curriculum Outcomes*

**STSE**

**Nature of Science & Technology**

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

**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 the result of the invention of a technology.

**Social & Environmental Contexts of Science & Technology**

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

**SKILLS**

**Initiating & Planning**

**212-1** Identify questions that arise from practical problems and issues and then determine way to investigate them.

**Performing & Recording**

**213-6** Use print and electronic research tools to collect information on a given topic.

**Analyzing & Interpreting**

**214-6** Apply and assess alternative theoretical models for interpreting knowledge in a given field.

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

**Communication & Teamwork**

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

**KNOWLEDGE**

**315-6** Describe factors that may lead to mutations in a cell's genetic information.

**315-7** Predict the effects of mutations on protein synthesis, phenotypes, and heredity.

**316-1** Describe historical and cultural contexts that have influenced evolutionary concepts.

**316-2** Evaluate the scientific evidence that supports the theory of evolution, and discussions concerning gradualism and punctuated equilibrium.

**316-3** Analyse evolutionary mechanisms such as natural selection, genetic variation, genetic drift, artificial selection, and biotechnology and their effects on biodiversity and extinction.

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

# Evolutionary Theory

*(5 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Explain various scientific hypotheses for the origin, development, and diversity of living organisms on Earth. (316-1, 316-4)
- Describe historical and cultural contexts that have influenced evolutionary concepts. (114-2, 115-7, 215-4, 316-1)
- Explain the theory of evolution and its importance to biological sciences. (114-2, 115-7, 214-17, 215-4, 316-1, 316-2, 316-4)
- Define the terms evolution, variation, natural selection and adaptation and be able to give examples of where scientists have shown these processes to occur in the natural world. (316-2)
- Explain the modern theory of evolution, punctuated equilibrium, current examples of selective pressures (natural and artificial), and demonstrate an understanding of the scientific evidence to support it. (114-2, 115-7, 116-2, 118-6, 316-2, 316-3, 316-4)

**Elaborations**

Students should research and evaluate various hypotheses on the origin and development of life. The creation of a time line may help students visualize geological time frames from the estimates of the earth's formation, early aquatic life, spread of life onto land, continued divergence of life forms, climatic changes, emergence onto land, the age of dinosaurs, and the appearance of humans.

Students should briefly investigate the ideas of Hutton, Malthus, Lamarck, Cuvier and Lyell and the way in which they influenced Wallace and Darwin in the development of the theory of evolution.

Students should demonstrate an understanding of the concepts behind Darwin's theory of evolution – some of the variation between individuals are heritable (genetic), those individuals best suited to their environment survive to reproduce and pass along genetic traits that are advantageous, and this process of natural selection results in changes to populations over time.

Students should become comfortable with the use of these terms and the differences between them..

Students should explore how some of the following support the theory of evolution:

- Mendelian genetics
- the fossil record with relative and radioactive dating
- geographic distribution of species
- homologous body structures
- embryology
- comparative anatomy
- vestigial physiology
- reproductive strategies
- universal genetic code
- biochemistry

## *Evolutionary Theory con't*

### Tasks for Instruction and/or Assessment

Paper & Pencil (115-7, 118-6, 213-6, 214-17, 316-2, 316-3, 316-4)
Select a modern organism and investigate the evolutionary evidence of its ancestry. Your report on this work may be visual (e.g. videotape, poster, models) or written.
*Assessment will be based on the accuracy and completeness of the research and on whether or not the presentation demonstrates knowledge and understanding of the concepts of evolution.*

Paper & Pencil (213-6)
Research a career that relates to this evolutionary unit and prepare a poster or portfolio on the knowledge and skills required for it. Be prepared to share your work with your classmates. Example careers are anthropologist, paleontologist, botanist, physiologist, entomologist, etc.
*Assessment is to be on the accuracy and completeness of the career description and on the effective communication of that information.*

Class research project (114-2, 115-7, 213-6, 316-1)
To illustrate the briefness of human existence create a timeline that illustrates the geologically recent event of human appearance on Earth. Tape a string along the wall to represent the history of the Earth as one single year. Date one end of the string as January 1 (the formation of Earth) and the other end at December 31 (the present). Have students research the timing of particular biological events based on current research (e.g. the appearance of single cells, the presence of dinosaurs, birds, mammals, major extinction events) and then place cards along the line where appropriate.

Lab Activity: Hominid Skull study
Use images of various hominoid (includes apes) skulls to generate data that is used to hypothesize ideas about human evolution, selective pressures and the features that made each group successful and/or lead to their extinction. Research and then develop a hominoid family tree.

As a class, discuss the common understanding of geological time in Darwin's day, the work of scientists before Darwin which provided evidence of the age of the Earth, and how Darwin's ideas of the relationship between the geologic time scale and the change in species composition was quite controversial.

Group research project (116-2, 213-6, 316-2)
In groups choose one of the topics below and have each member of the group find one example within that topic which supports the modern theory of evolution. Present your findings to each other and then develop a presentation (verbal, poster, electronic) for the whole class which integrates everyone's research into a cohesive format.

- Mendelian genetics
- the fossil record with relative and radioactive dating
- geographic distribution of species
- homologous body structures
- embryology
- comparative anatomy
- vestigial physiology
- reproductive strategies
- universal genetic code
- biochemistry

### Notes

***PH Biology***
*pp. 368-386*

*"Writing in Science" p.375*
*"Quick Lab" p.379*
*"Exploration" p.387*

**cbe/cbp-5153**

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

# Mechanisms and Patterns of Evolution

*(5 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Describe some of the ways in which genes can change and become the basis of variation within a population of organisms and within viruses. (315-6, 315-7)
- Analyze the role of sexually produced genetic variations and mutations in the process of natural selection. (115-7, 316-3)
- Explain the Hardy-Weinberg principle, and its role in population genetics. (116-2, 212-1, 213-6, 214-17, 215-4, 316-2, 316-3, 316-4)
- Describe how natural evolution of organisms has been impacted by environmental pressures and human intervention. (114-2, 114-5, 115-7, 118-6, 214-6, 215-4, 316-2)

***Biology 121***

- Extend their understanding of the Hardy-Weinberg principle by adding Chi-Square calculations.(316-2, 316-3, 316-4)

**Elaborations**

Students should identify and explain the genetic basis of variation including mutation, sexual mixing, genetic drift, cell conjugation, bacterial transformation and virus activity. They should explore both the positive and negative results of genetic variation through evolutionary time.

Students should explore the ways in which variations found in populations (e.g. seed size, fur or body colour, timing of growth or emergence, aggressiveness) impact on organism survival and reproduction and how this relates to natural selection.

They should also compare and contrast artificial selection by humans, with natural selection.

Students should understand the application of the Hardy-Weinberg principle and gene pool stability and change, and practice calculations using this principle.

Students should investigate and discuss the mechanism and cause of antibiotic resistant microbes, pesticide resistant insects, herbicide resistant plants, and dark-coloured peppered moths.

Students should explore some of the patterns of evolution that have occurred over time such as extinction, speciation, adaptive radiation, convergent evolution, co-evolution and gradualism or punctuated equilibrium.

Students should investigate the causes of various extinctions to determine whether they occurred naturally or were a result of human activity. This discussion could be expanded to consider the potential causes of future extinctions, and how an increased rate of extinctions might affect genetic biodiversity.

## *Mechanisms and Patterns of Evolution con't*

### Tasks for Instruction and/or Assessment

**Presentations** (213-6, 214-17, 215-4, 316-1, 316-2, 316-3, 316-4)
Use library and electronic research tools to collect authentic information on a topic related to evolutionary theory and prepare a class presentation and/or a written report. Sample topics may include:

- the role of viruses in the evolutionary process
- the origin of life on earth
- exobiology

*Assessment will be based on the depth of research, the level of understanding of the topic and the effectiveness of communicating that understanding.*

**Journal** (118-6, 316-3)
Reflect on this statement and develop, present and defend your own position based on scientific thinking.

**"**It has been stated that we are in the midst of the 'sixth extinction'. According to scientific evidence, such a rate of extinction has occurred only five times since complex life has emerged, and each time it was due to a catastrophic disaster. It has been said that this 'sixth extinction' is not however, occurring due to natural causes, but due to *Homo sapiens.* We are being called the exterminator species!"

### Notes

***PH Biology***
*pp. 392--410, 435-439*

*"Quick Lab" p.401*
*"Issues in Biology" p.403*
*"Analyzing Data" p.408, 438*
*"Exploration" p.411, 441*

**cbe-5169/ cbp-5162**

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

# BIOLOGY 12

## *UNIT 3 – Maintaining Dynamic Equilibrium II*

### *Introduction*

Cells, tissues, organs, organ systems and ultimately organisms must maintain an internal biological balance or homeostasis despite changing external and internal conditions. Equilibrium is maintained as long as the body systems are active (dynamic) in a continuous series of checks and balances as a response to internal and external changes. This unit explores the nervous (electrochemical) and endocrine (chemical) systems that trigger and communicate changes. Reproduction and development are studied with reference to these internal communication systems.

### *Curriculum Focus*

This unit focuses on scientific inquiry, observation, and decision-making (STSE) as social and environmental issues are considered. The STSE component contributes to the development of scientific literacy and a sense of global citizenship. Problem solving skills are developed through discussions concerning electrochemical and chemical control systems, and concerning the potential impacts of reproductive technologies.

### *Curriculum Links*

Biology students have studied the components of body systems at a number of different levels prior to Biology 12. Students in Grade 2 are introduced to the importance of maintaining a healthy lifestyle, life cycles of familiar animals and the changes that humans undergo as they grow. At the Grade 5 level students begin to relate body changes to growth and development to the role played by body systems in helping both humans and other organisms grow and reproduce. The major components of the structure and function of the digestive, excretory, respiratory, circulatory and nervous systems are introduced. The skeletal, muscular and nervous systems and their contributions to movement are also integrated into this study. In addition, body defenses against infection and nutritional requirements to promote health are discussed.

When students reach Grade 8, they begin to consider the basic factors that affect the functioning and efficiency of the human respiratory, circulatory, digestive, excretory and nervous system and they are encouraged to discover and describe examples of the interdependence of various systems of the human body. They are also asked to explain that growth and reproduction depend on cell division. The Grade 9 Reproduction unit introduces the topics of cell division, asexual and sexual reproduction. This provides a good background for the study of the role of systems in the maintenance of homeostasis within an organism. A cross-curricular link exists between the life sciences and physical sciences in the discussion of dynamic equilibrium incorporated into APEF Chemistry and Physics.

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

**STSE**

**Nature of Science & Technology**

**115-1** Distinguish between scientific questions and technological problems.

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

**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.

**16-4** 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.

**117-11** Analyse examples of Canadian contributions to science and technology.

**118-4** Evaluate the design of a technology and the way it functions on the basis of a variety of criteria that they have identified themselves.

**118-6** Construct arguments to support a decision, using examples and evidence and 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.

**118-10** 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**

**212-3** Design an experiment identifying and controlling major variables.

**212-6** Design an experiment and identify specific variables.

**212-8** Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making.

**Performing & Recording**

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

**213-4** Estimate quantities.

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

**213-7** Select and integrate information from various print and electronic sources or from several parts of the same source.

Analyzing & 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.

**214-18** Identify and evaluate potential applications of findings.

**Communication & Teamwork**

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

**KNOWLEDGE**

**313-3** Analyse and describe the structure and function of female and male mammalian reproductive systems.

**313-4** Explain the human reproductive cycles.

**313-5** Explain current reproductive technologies for plants and animals.

**313-6** Evaluate the use of reproductive technologies for humans

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

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

**314-4** Explain the critical role of enzymes in cellular metabolism.

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

**317-2** Analyse homeostatic phenomena to identify the feedback mechanisms involved.

**317-4** Evaluate the impact of viral, bacterial, genetic and environmental diseases on an organism's homeostasis.

**317-5** Evaluate, considering ethical issues, the consequences of medical treatments such as radiation therapy, cosmetic surgery and chemotherapy.

**317-7** Describe how the use of prescription and nonprescription drugs can disrupt or help maintain homeostasis

# Nervous and Endocrine System - *neuron structure and function*

*(10 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Diagram and explain the structure of a neuron. (317-1)
- Describe the basic structure and function of sensory neurons, motor neurons and interneuron's, using the concept of the reflex arc. (317-1)
- Describe the transmission of an impulse. (317-1)
- Identify the role of certain compounds to neuron function: oxygen, glucose, ATP, sodium ions.(314-2)
- Explain, in general terms, the ion distribution on the membrane of a neuron and the influence of myelin. (317-1)

### *Biology 121*

- Demonstrate an understanding of natural and artificial transmitters and inhibitors of the nervous system. (314-2, 317-1)

### Elaborations

The nervous system is responsible for receiving information from internal and external stimuli and the quick response to that information. While bacteria, protists and some plants are capable of nervous response, animals are the only organisms that possess true nervous systems.

Four requirements are necessary for a nervous response to occur: sensory receptors to detect a stimulus (skin, eye, ear); a method for impulse transmission (neurons); interpretation and analysis of impulses (brain, spinal chord); a response carried out by an effector (muscle, gland).

Cells within the nervous system require enormous amounts of energy to function. This energy is provided by the processing of glucose and the production of ATP within these tissues, requiring an adequate supply of carbohydrates and oxygen.

Students should identify structures and functional similarities and differences between sensory, motor and interneuron's (especially within the concept of the reflex arc). Students should describe neuron stimulation related to the sodium-potassium pump.

Describe the transmission of an impulse along the length of a neuron, and across a synapse or neuromuscular junction. Describe the effects of transmitters, acetylcholine and neural inhibitors cholinesterase

### Teaching Suggestions

Students can observe microscopically the structure of neurons and neuromuscular junctions on prepared microscope slides within the laboratory.

Students may investigate the neurological and physiological basis behind the effectiveness of acupuncture and the production of a "runners high".

Students can investigate how nerve poisons interfere with synaptic transmission (curare, botulism, tetanus, organophosphate pesticides, nerve gas).

## *Nervous and Endocrine System - neuron structure and function con't*

### Tasks for Instruction and/or Assessment

**Laboratory Activities** (212-6, 213-4, 213-5, 214-10, 215-2, 317-1)
Perform the available laboratory activities provided to illustrate some aspects of the nervous system.
These may include:

- Activities to investigate reflex times.
- Microscopic examination of components of the nervous system.
- Dissection of specimens, or observation of models in order to observe the structure of the nervous system.
- Observation of the behaviour in response to stimuli of specimens like Planaria.
- Effect of the stimulant caffeine on Daphnia.

*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** (317-1, 317-4, 317-7)
Working within your assigned groups, select a nerve poison to investigate. Report to the class on the physiological effect it has on the nervous system, its source, and the historical and/or current reasons for its use.
Working within your assigned groups, select a substance (chocolate might be an example) or procedure (acupuncture) that affects the nervous system. Report to the class on its physiological effect on the nervous system.

### Notes

***PH Biology*** *pp. 897-900*

**cbe/cbp-0352**

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

# Nervous and Endocrine System - *central and peripheral nervous systems*

*(3 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Explain the basic structure and function of the central nervous system. (116-7, 317-1)
- Describe the basic functions of a peripheral nervous system. (116-7, 317-1)
- Investigate the physiology of reflex arcs. 212-6, 213-4, 213-5, 214-10, 215-2)
- Describe how the nervous system helps maintain homeostasis. (317-1)
- Describe disorders linked to the nervous system and their effect on the homeostasis of the system and the organism as a whole. (317-1, 317-4)
- Describe how the use of drugs can have a role in disrupting homeostasis. (317-7)

***Biology 121***

- Describe how the use of prescription and non-prescription drugs can have a role in maintaining or disrupting homeostasis. (317-7)

### Elaborations

Students should describe the basic structure and function of the central nervous system, including the cerebrum, cerebellum, medulla, and spinal chord.

Students should be given the opportunity to observe the principal features of the brain, using models, dissected mammalian brains or computer simulations, and to identify and label major physical structures and their functions from drawings or photos of that organ.

Students should describe the basic functions of a peripheral nervous system including the Somatic and Autonomic Nervous systems, the reflex arc, and the sympathetic and parasympathetic nervous systems.

In exploring the peripheral nervous system students should design and/or perform experiments to investigate the physiology of reflex arcs such as pupil dilation, knee jerk reaction, and reaction time. Students should design and/or perform experiments to investigate sensitivities to heat, cold, pressure, touch, and/or taste.

Specific pathologies of the nervous system should be discussed and/or researched along with the capability of technology to diagnose, treat or cure the problem. During this discussion students should investigate the physiological basis and causes of neurological diseases and discuss the effectiveness and the ethics of new innovative treatments.

Research the current understanding of the link between psychological disorders of the nervous system (e.g. depression, schizophrenia) and the use of marijuana and other drugs.

### Teaching Suggestions

Students can prepare a chart to visually contrast the sympathetic and parasympathetic components of the autonomic nervous system on various parts of the body (e.g. heart, digestive tract, blood vessels, bladder, bronchi, eye).

Laboratory investigations of the touch receptors of the skin and the taste receptors of the tongue can be used to illustrate their differential distribution.

Possible nervous system disorders to investigate could be selected from the following: Alzheimer's, Parkinson's, epilepsy, meningitis, polio, stroke, Bell's palsy, mental disorders related to chemical imbalances, or the consequences of damage or injury to the nervous system causing stroke, or spinal injury. For each condition studied students should explore diagnosis, causes, and the effectiveness and ethics behind the treatment or cure.

***Biology 121*** - Students should analyze evidence concerning the influence of anesthetics, drugs and chemicals, natural and synthetic, on the functioning of the nervous and endocrine systems and their relationship to addiction theory (e.g. nicotine, morphine, LSD).

***OR***

Students should compare the relative physiological and societal impacts of chemical and drug use on adult development as compared to fetal development.

# *Nervous and Endocrine System - central and peripheral nervous systems con't*

## Tasks for Instruction and/or Assessment

Laboratory Activities (212-6, 213-4, 213-5, 214-10, 215-2, 317-1)
Perform the available laboratory activities provided to illustrate some aspects of the nervous system. These may include activities to investigate the sensitivity of the touch receptors of the skin and/or the taste receptors of the tongue.

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

Presentations (317-1, 317-4, 317-7)
*Expose students to experts on nervous system pathologies by using community resources such as physicians, organizations (Alzheimer Society, Parkinson Foundation, Heart and Stroke Foundation, Canadian Mental Health Association, Multiple Sclerosis Society), sufferers of, or caregivers of those who possess these disorders.*

*Expose students to experts on the influence of the use of prescription and non-prescription, legal and illegal drugs on the maintenance of homeostasis within the human system by using community resources such as physicians, pharmacists and available organizations*.

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.*

Paper & Pencil (115-5, 116-4, 117-2, 117-4,118-8, 118-10, 214-9, 317-7)
Select a nervous system disorder or injury. Research the modern treatments for it. You will be expected to make a brief presentation to the class and submit a written report.

*Assessment will be based on the quality of the information presented to the class and the written report.*

Select a particular pharmaceutical or drug to investigate. Include the sources of the chemical, medical or non-medical uses, effects of use, and any other appropriate information. You will present your information to the class. This will provide for a comprehensive overview.

*Assessment will be based on the completeness and accuracy of information obtained*.

### Notes

***PH Biology***
*pp. 901-904, 910-914*

*"Quick Lab" p.903, 905*
*"Analyzing Data" p. 913*

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

# Nervous and Endocrine Systems – *glands and hormone action*

*(3 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will*:

- Identify the location and function of principal endocrine glands in humans, and identify hormones, their source gland, and their general effect on humans. (116-7, 317-1, 317-2)

**Elaborations**

Students should be provided with the opportunity to observe the principal features of the endocrine system, utilizing models, computer simulations and to identify and label those structures through the use of drawings or photographs. Students should identify the following endocrine glands: pineal, hypothalamus, pituitary, thyroid, adrenal, pancreas islets, ovaries, and testes.

Students should identify the following hormones, their source gland, and their general effect on humans: I– thyroxine, epinephrine, norepinephrine, somatotrophin (HGH – human growth hormone)

- Describe how the endocrine system helps maintain homeostasis. (317-1)

The endocrine system of animals releases chemical hormones into the blood to help maintain homeostasis by causing or preventing change in specific organs or tissues of the body. The endocrine system is slower in producing an effect than the nervous system; however, it has a more sustained effect. Students should recognize that the nervous system and endocrine system work together in a coordinated fashion.

- Describe an example of neural and endocrine control systems acting together in animals. (116-7, 317-1, 317-2)

- Understand the general concept of a hormone and target cell or organ. (317-1)

Students should examine diagrams that illustrate the location of receptors for protein hormones compared to steroid hormones. In doing this, they should recognize the importance of the solubility of steroid hormones in the cell membrane and the critical nature of the shape of protein hormones.

- Explain how protein and steroid hormones cause changes in target cells. (314-3, 317-1)

**Teaching Suggestions**

Students may research, identify and summarize the main hormonal and nervous components of reactions to stress. They may discuss why some individuals may experience the following symptoms when they are nervous – cool hands, knots in their stomach, dilated pupils, dry mouth, rapid heart rate.

***Biology 121***

- Design an experiment to investigate and collect data on selected aspects of the endocrine system and identify specific variables involved. (212-6, 213-4, 213-5, 214-10)

***Biology 121* Teaching Suggestions**

An experiment can be designed to collect quantitative or qualitative data on the varying heartbeat of *Daphnia* in response to substances such as epinephrine, alcohol, regular and caffeine-free cola, or hormones such as ADH (antidiuretic hormone), cortisol, and aldosterone The data can be compared, interpreted and extrapolated to explore the question: "Based on the results of this experiment, what effects might you expect these chemicals to have on the heartbeat of humans?"

# *Nervous and Endocrine Systems – glands and hormone action con't*

## Tasks for Instruction and/or Assessment

Laboratory Activities (212-6, 213-4, 213-5, 214-10, 215-2, 317-1)
Perform the laboratory activities provided to illustrate some aspects of the endocrine system. These may include:

- Microscopic examination of the pancreas to distinguish endocrine tissue from digestive enzyme producing tissue.
- Effect of epinephrine on the heartbeat of Daphnia.
- Development of models to illustrate visually the concept of negative feedback.
- Metamorphosis of tadpoles.
- Growth of plants in response to hormonal stimulation.

*Assessment would depend on the nature and depth of the activities selected. Some of these activities involve the collection of data that maybe tabulated and graphed*

**Presentations**
(115-5, 117-4, 118-8, 118-10, 213-5, 317-1, 317-5, 317-7)
Within a debate format you will be required to display the results of research and "argue" against other stakeholders concerning issues such as:

- Should doctors prescribe HGH as a treatment for
- Individuals who have normal levels of human growth hormone in their system yet are genetically shorter than average, simply as a means to increase their height?
- Should steroids (performance enhancing drugs) be legalized for use by all athletes? Should random drug testing of athletes be permitted or is it an invasion of privacy?
- Should hormones be used within the beef, milk or poultry industry to increase production?

*Assess the participation of students, preparation of the argument, thoroughness of the research and their familiarity with the topic.*

**Laboratory Activities** (213-5, 314-3, 314-4)
Develop a visual model that illustrates enzyme function. The design of these models may range from physical ones to visual animations, so you can be creative!
*Assessment will be based on the accuracy and effectiveness of the product submitted and/or presented to the class.*

## Notes

***PH Biology***
*pp. 996-1008*

*"Writing in Science" p.1008*

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

# Nervous and Endocrine Systems - *homeostasis and feedback mechanisms*

*(4 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Analyze homeostatic phenomena to identify the feedback mechanisms involved in the endocrine system. (317-2)

- Investigate the role played by Frederick Banting and Charles Best in the discovery of insulin. (117-11)

- Demonstrate an understanding of the relationship between human health and feedback loops (e.g. diabetes) (317-1, 317-4)

- Describe disorders linked to the secretions of the endocrine system and their effect on the homeostasis of the system and the organism as a whole. (317-1, 317-4)

### Elaborations

Students should be able to use flow charts to describe representative positive and negative feedback mechanisms in living systems.

Within the discussion of the hypothalamus-pituitary complex include RF (releasing factor), pituitary hormones and the target tissues (e.g. TSH on thyroid).

Students should be aware of the importance of Canadian researchers Frederick Banting and Charles Best in the discovery of insulin and the control of diabetes.

Students should discuss the effect on organisms of the oversecretion (hypersecretion) or undersecretion (hyposecretion) of hormones (e.g. insulin).

### Teaching Suggestions

They may compare technological feedback control systems with the natural electrochemical control systems of organisms and discuss the sensitivity, response time and effectiveness.

Sample data of blood and/or urine composition can be analyzed and interpreted in order to infer the role of hormones in homeostasis.

Students may perform an experiment to investigate the presence of sugar in simulated urine samples, and compare the results with other urinalysis data (note: hormonal feedback systems can be illustrated in the Reproduction Unit).

Using a table, students may compare the conditions of juvenile diabetes and adult-onset diabetes. Headings may include the age of onset, cause, severity and the method of treatment. Students may research and present modern approaches to the detection, treatment and control of diabetes.

Students can discuss the social, ethical and health issues associated with hormone therapy in humans (e.g. growth hormones, steroid use in sports, hormone use to slow the effects of aging or to minimize jet lag).

## *Nervous and Endocrine Systems - homeostasis and feedback mechanisms con't*

**Tasks for Instruction and/or Assessment**

Presentations (117-4, 317-1, 317-4, 317-7)
*Expose students to experts on endocrine system pathologies by using community resources such as physicians, organizations (Canadian Diabetes Association) or sufferers of these disorders.*

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.*

Pencil & Paper (116-7, 317-1, 317-2)
You will be provided with a partial flow chart to illustrate hormones and feedback systems within the human body. Working in groups, complete the chart. When this is complete, within your own group, develop partial charts of your own design for completion by other groups within the class. Analyze and interpret the data provided on blood or urine composition. Use the flow chart to determine the role of hormones in homeostasis.

Paper & Pencil (317-1, 317-7)
Prepare a short report on the role played by Canadian researchers Frederick Banting and Charles Best in the discovery of insulin.
*Assessment will be based on quality of work submitted*.

Laboratory Activities (212-6, 213-4, 213-5, 214-10, 215-2, 317-1)
Develop a physical working model to illustrate visually the concept of negative feedback.

Observation (116-7, 317-1)
Within your groups develop a concept map for the electrochemical and chemical control systems that will illustrate their close integration and interconnected nature.
*Assessment will be based on student participation and the final product as appropriate*.

Paper & Pencil (317-1)
Select a hormone and investigate the effects of its oversecretion and undersecretion in the body. Prepare a visual display to illustrate this. Hormones may include:

- HGH
- Aldosterone
- Cortisol
- Thyroxine
- Insulin
- glucagon.

**Notes**

***PH Biology***
*pp. 1000-1002*

*"Exploration" p.1025*

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

## *Biology 121* Nervous and Endocrine System - *the brain, the eye, the ear*

*Complete one or more of the following topics, as time permits*

### *NB Prescribed Outcomes*

*It is expected that students will:*

- Describe the structure and function of the brain: meninges, cerebrospinal fluid, cerebrum, cerebellum, brain stem, thalamus, hypothalamus (317-1)
- Describe the general structure and function of the eye: lens, iris, cornea, retina, vitreous fluid, choroid, fovea, rods, cones, blind spot. (116-7, 317-1)
- Describe the general structure and function of the ear: tympanic membrane, ossicles (hammer, anvil, stirrup), eustachian tube, semicircular canals, cochlea (116-7, 317-1)
- Investigate the effect of diseases, malformations, and injury on the brain, eye, and ear, and the corresponding mechanical solutions or medical treatments (115-5, 116-4, 317-5)

### Elaborations

This section should be developed as time permits, and student interest directs.

### Teaching suggestions

***The Brain***

Beyond brain structure, students can research the work of Dr. Wilder Penfield at McGill University, which explores the effect of brain injury or disease on behaviour, and looks at brain surgery as a solution to epilepsy.

The case study of Phineas Gage is a classic story of the effect of brain injury on behaviour.

***Eyes and Ears***

Students should observe the principal features of the mammalian eye or ear, using models, dissected structures or computer simulations, and identify and label major visible structures and their functions from drawings or photos of those organs.

The investigation of sense organs serves as a cross-curricular link with the waves/sound/light sections of high school physics.

Students could design and/or perform experiments to test their abilities to distinguish objects visually and to hear a range of sounds.

Treatments for visual and auditory disorders may include cornea transplants, laser surgery, cataract surgery, corrective lenses and hearing aids.

Students could research and discuss the potential health effects of repeated exposure to loud noises (noise pollution) and extended wear contact lenses.

***Eyes***

Students can investigate focal length in relation to near and far sightedness, colour blindness, optical illusions etc.

Students may discuss the causes and treatments for the common visual defects of nearsightedness and farsightedness. Students may also research the development of new technologies for the treatment of sensory malfunctions (e.g. corneal laser surgery, cochlear and digital implants).

Student laboratory activities dealing with the sensory organ of the eye can illustrate binocular vision, dominant eye, focusing, resolution, blind spot and retinal fatigue.

# *Biology 121*
## *Nervous and Endocrine System - the brain, the eye, the ear con't*

### Tasks for Instruction and/or Assessment

Paper & Pencil (115-5, 116-4, 117-2, 117-4, 317-1, 317-5)
Investigate the development of new technologies for the correction of malfunctions of the sense organs and/or the potential health effects of environmental factors such as noise pollution and extended wear contact lenses. Be prepared to present your findings to the class.

*Assessment may be based on the completeness and accuracy of research as observed during the presentation to the class by the students or through a written summary.*

Presentations (117-4, 317-1, 317-4, 317-5)
*Expose students to experts on sensory organ pathologies by using community resources such as physicians, organizations (Canadian National Institute for the Blind, Eye Banks, Canadian Association for the Deaf and Blind), corneal transplant recipients or sufferers of these disorders.*

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, 317-1)
Following the procedure outlined, dissect the sheep eye provided, and identify the parts. Complete the table that relates the structure of the parts of the eye with their function.

### Notes

***PH Biology***
*pp. 901 – 903*
*pp. 906-909*

*"Real World Lab" p.915*

***cbe-0354***

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

# **Human Reproduction** – *male and female reproductive systems*

*(5 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Identify the structures of the male reproductive system and describe their functions. (116-7, 313-3, 313-4)
- Describe the structure of sperm. (313-3, 313-4)
- Identify and describe the function of the principal reproductive hormones of the human male (116-7, 313-3, 313-4)
- Identify the structures of the female reproductive system and describe their functions. (116-7, 313-3, 313-4)
- Describe the structure of egg cells. (313-3, 313-4)
- Identify and describe the function of the principal reproductive hormones of the human female. (116-7, 313-3, 313-4)

### Elaborations

Students should be provided with the opportunity to observe and discuss the function of the principal features of the male reproductive system using models or computer simulations, and to identify and label the major structures from drawings or photos of that organ system. Include: penis, testis, scrotum, seminiferous tubules, epididymis, sperm duct (vas deferens), Cowper's (bulbourethral) gland, seminal vesicle, prostate, urethra

Students should identify and describe the role of the principle male hormones - testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH) – and should explain their interactions in the maintenance and functioning of the reproductive system and the development of primary and secondary sex characteristics.

Students should be provided with the opportunity to observe and discuss the function of the principal features of the female reproductive systems using models or computer simulations, and to identify and label the major structures from drawings or photos of that organ system. Include: ovary, follicles, oviduct (fallopian tube), uterus, endometrium, myometrium, cervix, vagina, urethra

Students should identify and describe the role of the principle female hormones – estrogen, progesterone, luteinizing hormone (LH), follicle stimulating hormone (FSH) – and should explain their interactions with the menstrual cycle, and in the maintenance and functioning of the reproductive system and the development of primary and secondary sex characteristics.

Students should relate the positive and negative feedback systems of the menstrual cycle to the 4 stages (Menstruation, Follicle Stage, Ovulation and the Corpus Luteum stage).

Students should be able to distinguish eggs and sperm from their supporting structures, using prepared slides of ovaries and testes.

Students should compare the structure of egg cells and sperm cells. Relative sizes, energy reserves, motility, numbers produced and the importance of the acrosome and numerous mitochondria within a sperm cell should be included.

### Teaching Suggestions

Students can do a case study on menstruation and monthly hormones respective to the female reproductive system.

## *Human Reproduction – male and female reproductive systems con't*

**Tasks for Instruction and/or Assessment**

Laboratory Activities (212-3, 212-8, 213-3, 215-2, 313-3)
Perform the available laboratory activities to illustrate some aspects of the reproductive process.
These may include:
Examination of prepared microscope slides of ovaries and testes (egg and sperm cells).
*Assessment would depend on the nature of the activities selected, ranging from the development of microscope diagrams to the answering of questions.*

**Notes**

***PH Biology***
*pp. 1009-1014*

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

# **Human Reproduction** – *fertilization, development and childbirth*

*(7 hours)*

## *NB Prescribed Outcomes*

| *It is expected that students will:* | **Elaborations** |
|---|---|
| • Trace the journey of sperm and egg from their origin to fertilization. (116-7, 313-3, 313-4) | |
| • Explain how fraternal and identical offspring are produced. (116-7, 313-2, 313-3, 313-4) | Students should recognize the distinction in the fertilization and initial embryonic development that produces identical and fraternal twins and discuss the mechanism in which multiple births (triplet, quadruplets) may result naturally. |
| • Identify chemical control hormones associated with implantation, embryo development, birth and lactation including: progesterone, oxytocin, and prolactin. (116-7, 313-3, 313-4) | |
| • Describe the basic stages of embryonic development. (313-4)<br>• Describe the functions of primary membranes during the embryonic development of animals including: yolk, allantois, amnion, and chorion. (313-4) | Students should have the opportunity to observe the stages of embryo development - cleavage, blastula, gastrula, germ layers, and neural development- through the use of preserved materials, prepared slides (starfish cleavage), audiovisual presentations or computer simulations, and extrapolate these events to the development of the human fetus. |
| • Describe the roles of the placenta and umbilical cord during pregnancy, and the process of childbirth. (116-7, 313-3, 313-4) | Students should be aware of the physiological events that occur during and after the process of childbirth (cervical dilation, loosening of pelvic ligaments, rupture of the amniotic membrane, uterine contractions, delivery of fetus and expulsion of the placenta) and the role of hormonal control |
| • Describe techniques and technologies used to monitor various stages of embryonic or fetal development. (116-2, 313-5, 313-6) | Students should be able to describe fetal monitoring techniques including blood tests, ultrasound and fetoscopy. They should also understand how an ultrasound operates. |
| • Describe techniques and technologies used to diagnose early genetic problems. (116-2, 313-6) | Students should compare the purposes of these fetal monitoring techniques to those genetic testing techniques such as amniocentesis and chorionic villus sampling. |
| • Investigate the effect of chemical and drug abuse on fetal development, and discuss the role that society should or should not take in the protection of the fetus. (213-7, 214-18, 313-4) | The societal impact of chemical and drug abuse on fetal development (alcohol, cocaine, cigarettes) should be investigated and the responsibility of individuals, society, and science researchers to prevent pre-natal damage should be explored and discussed. |

## *Human Reproduction – fertilization, development and childbirth con't*

**Tasks for Instruction and/or Assessment**

Paper & Pencil (313-4)

Analyse the data on blood hormone levels and physiological events collected during a female menstrual cycle and investigate how the cycle is regulated.

*Assessment will be based on the logical analysis of data and the conclusions drawn.*

Presentations (213-7, 215-2, 313-3, 313-4)

*Expose students to experts in a variety of aspects of human reproductive health and sexually transmitted diseases by using community resources such as physicians or available organizations (Sexual Health Centers).*

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 (313-4)

Perform the laboratory activities available on the process of development. These might include:

- microscopic examination of prepared slides of stages of starfish cleavage or sea urchin development
- observation of embryo development in the frog utilizing a culture of frog eggs

*Assessment would be based on the nature and depth of the activities selected, ranging from the development of microscope diagrams, answering of questions, to a more detailed discussion.*

Students can discuss and consider, from a variety of perspectives (e.g. counselor, prospective parents, potential patient), the personal and ethical considerations raised by genetic counseling and gene testing in the identification and treatment of fetal abnormalities or deficiencies, or potentially debilitating genetic conditions such as Tay Sachs, Phenylketonuria, Huntington Disease and Alzheimer's.

**Notes**

***PH Biology***
*pp. 1016-1023*

*"Quick Lab" p.1022*

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

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# Human Reproduction - *reproductive technologies*

*(3 hours)*

## *NB Prescribed Outcomes*

*It is expected that students will:*

- Evaluate the use of currently available procedures and technologies to increase fertility. (118-6, 118-8, 313-5, 313-6)

- Explain how and at what rate the use of various procedures and technologies decrease the chance of conception. (118-4, 313-5, 313-6)

***Biology 121 Optional***

- Assess the effects of birth control technology on the population demographics of various countries with varying levels of access. (313-6)

- Debate the merits of funding solutions to human fertility problems versus the funding of human population control. (117-4)

### Elaborations

Students should evaluate a range of procedures and technologies used to increase fertility and the ethical and practical issues involved. Examples may include use of fertility drugs, embryo storage, in-vitro fertilization (IVF), superovulation of donor with gonadotrophins, artificial insemination (AI), nonsurgical removal of embryos, transfer of embryo to surrogate, or birth after embryo transfer.

Students should research and explain various methods of controlling conception, their effectiveness, and problems and side effects of each method. Methods may include the calendar method; hormonal treatments such as "the pill", injections, or a patch; use of a diaphragm, sponge, or morning after pill; or undergoing a vasectomy or tubal ligation.

**Teaching Suggestions**

Students may evaluate from published data the relative effectiveness of various methods of contraception and perform a risk/benefit analysis on the implementation of these for various segments of the population.

***Biology 121 Optional***

Students may investigate the methods of population/birth control of various countries around the globe and assess the effects of these on the demographics of these countries.

Students may debate the merits of funding solutions to human fertility problems versus the funding of human population control.

# *Human Reproduction - reproductive technologies and ethical considerations con't*

## Tasks for Instruction and/or Assessment

Paper & Pencil (115-1, 116-2, 117-4, 313-5, 313-6)
Research and evaluate the use of currently available reproductive technologies.
The following are potential options:

- artificial insemination (AI),
- superovulation using gonadotrophins,
- in-vitro fertilization (IVF),
- in- vitro maturation (IVM),
- surrogate motherhood,
- Hormonal treatment allowing pregnancy after menopause.

You will be expected to present a brief summary of your topic to the class.
Research and evaluate types of contraception that are being promoted for the use of population control within developing countries.
You will be expected to present a brief summary of your topic to the class.

*Assessment will be based on the accuracy and relevancy of the information gathered and completeness of the research based on a class presentation.*

Presentations
(115-1, 118-4, 215-2, 313-5, 313-6)
*Expose students to experts on a variety of aspects of reproductive technologies and issues by using community resources such as physicians, reproductive technologists, public health workers or representatives from available related organizations (Planned Parenthood).*

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 on answers provided to one of their questions.*

**Notes**

Not covered in text

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

# Appendix A - 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.