This document was written primarily for:

<table>
<thead>
<tr>
<th>Audience</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>✓</td>
</tr>
<tr>
<td>Teachers</td>
<td>✓ of Biology 30</td>
</tr>
<tr>
<td>Administrators</td>
<td>✓</td>
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<tr>
<td>Parents</td>
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<td>General Audience</td>
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<td>Others</td>
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Alberta Education, Government of Alberta
2019–2020

*Biology 30 Information Bulletin*

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Please note that if you cannot access one of the direct website links referred to in this document, you can find diploma examination-related materials on the [Alberta Education website](https://www.alberta.ca/).
Introduction

The purpose of this bulletin is to provide teachers of Biology 30 with information about the diploma examinations scheduled in the 2019-2020 school year. This bulletin should be used in conjunction with the current Biology 30 Program of Studies.

This bulletin includes descriptions of the Biology 30 Diploma Examinations that will be administered in November 2019 and January, April, June, and August 2020; clarifications of some aspects of the examinations; descriptions of trends in student performance on previous examinations; and other subject-specific information.

Teachers are encouraged to share the information in this bulletin with their students.
Examination Security

All Biology 30 Diploma Examinations will be held secure until they are released to the public by the Minister. No secure diploma examination is to be previewed, discussed, copied, or removed from the room in which the examination is being written. However, for the January and June examinations, teachers will be allowed access to a Teacher Perusal Copy for review purposes one hour after the examination has started. All diploma examination booklets must be kept secure, with the exception of Part A: Written Response in the January and June administrations of humanities examinations after they have been written. Unused copies of all secure examination booklets must be returned to Alberta Education.

For more information about teacher perusal copies and examination security, please refer to the General Information Bulletin.

Time Limits on Diploma Examinations

All students may use extra time to write diploma examinations. This means that all students have up to 6 hours to complete the Biology 30 Diploma Examination, if they need it. The examination is nevertheless designed so that the majority of students can complete it within 3 hours. The examination instructions state both the designed time and the total time available.

Extra time is available for diploma examinations in all subjects, but the total time allowed is not the same in all subjects. For more information about accommodations and provisions for students, please refer to the General Information Bulletin.
Maintaining Consistent Standards over Time on Diploma Examinations

A goal of Alberta Education is to make scores achieved on examinations within the same subject directly comparable from session to session, to ensure fairness to students across administrations.

To achieve this goal, the examination has a number of questions in common with a previous examination. Common items are used to find out if the student population writing in one administration differs in achievement from the student population writing in another administration. Common items are also used to find out if the unique items (questions that have never appeared in a previous examination) differ in difficulty from the unique items on the baseline examination that sets the standard to which all students are held.

A statistical process called equating adjusts for differences in difficulty between examinations. Examination marks may be adjusted depending upon the difficulty of the examination written relative to the baseline examination. Therefore, the resulting equated examination scores have the same meaning regardless of when and to whom the examination was administered. Equated diploma examination marks are reported to students. More information about equating is available here.

Because of the security required to ensure fair and appropriate assessment of student achievement over time, Biology 30 Diploma Examinations will be fully secured and will not be released at the time of writing.
Diploma Examinations: Multiple Forms

As part of Alberta Education’s commitment to fairness to students and flexibility in the writing of diploma examinations, there are two distinct forms (versions) of diploma examinations in some subjects during major administrations (January and June). The two forms are equated to baseline examinations to ensure that the same standard applies to both forms. Both forms adhere to the established blueprint specifications and are reviewed by a technical review committee.

To facilitate the analysis of school-level results, each school receives only one examination form per subject. In subjects offering a translated French-language examination, both forms are administered in English and in French.

For more information, contact

Deanna Shostak
Director, Diploma Programs
780-422-5160 or Deanna.Shostak@gov.ab.ca

or

Pascal Couture
Director, Exam Administration
780-643-9157 or Pascal.Couture@gov.ab.ca
Field Testing

Field testing is an essential stage in the development of fair, valid, and reliable provincial examinations. Field testing is a process of collecting data on questions before they become part of a diploma examination. Potential diploma examination questions are administered to students in diploma courses throughout the province to determine their difficulty level and appropriateness. Each field test requires a large student sample to provide the examination developers with reliable information (statistical data and written validation comments from teachers and students).

How do field tests help teachers and students?

Teachers receive each student’s score promptly, gaining useful information about their students’ performance. Students benefit from writing a test that duplicates some of the experience of writing a diploma examination. Field tests provide students and teachers with examples of the format and content of questions that may appear on diploma examinations. Finally, because of field testing, students, teachers, and parents can be reassured that the questions on diploma examinations have undergone a rigorous process of development, improvement, and validation.

How are field-test data used?

The data received from field tests indicate the validity, reliability, and fairness of each question. Questions that meet specific standards are selected for use on future diploma examinations.

Some questions or sets of questions may not initially perform as well as we require. These questions may be revised and field tested again. Revisions are influenced by the written comments of students and teachers, who provide valuable advice about the appropriateness of the questions, adequacy of writing-time limits, test length, text readability, artwork/graphics clarity and suitability, and question difficulty.

Science field tests

All Grade 12 science field tests are offered exclusively through the Quest A+ online delivery system. These include purely digital field tests; and hybrid field tests, in which students receive a paper copy of the test but must respond to the questions online.

Students should use paper data booklets or data pages for all science field tests. These resources will also appear in the online delivery system. Students should also have scrap paper, which may be accessed and downloaded from the “Teacher Resources” section on the homepage of the Field Test Request System. All paper data sheets or scrap paper with markings must be securely shredded at the end of the field-test administration.

Teachers have a 24-hour period to peruse digital or hybrid field tests and are provided with data on how their students performed. These data include the proportion of students who chose each alternative for multiple-choice items and the proportion who left a numerical-response item blank. Test items are blueprinted to program of studies outcomes, which allows teachers to use field-test results to learn more about their students’ strengths and weaknesses.
Once logged into the digital or hybrid field test on the online delivery system, teachers have the same length of time to peruse the test as their students did to write it. Teachers might choose to log into the field test, submit the confidentiality form, and then log out of the test, so that they can finish perusing the test after receiving their students’ data.

It is important to note that the security of field-test items remains vital to the administration of diploma examinations. Participating teachers must commit to maintaining the security of field-test items. In the case of hybrid field tests, paper copies mailed to schools must be kept secure by the school principal until administration. After the administration of a hybrid field test, all paper copies must be mailed back to Alberta Education.

More information about field-test administration and security is available here.

**How can teachers request field tests?**

Teachers requesting field tests must have a Public Authentication System (PAS) account. All requests are made through the Field Test Request System. Further information, including the closing dates to request a field test, may be obtained here, or by contacting Field.Test@gov.ab.ca. Practice tests are available online.

**For more information, contact**

Deanna Shostak  
Director, Diploma Programs  
780-422-5160 or Deanna.Shostak@gov.ab.ca

or

Pascal Couture  
Director, Exam Administration  
780-643-9157 or Pascal.Couture@gov.ab.ca
Special-format Practice Tests

To give students an opportunity to practise diploma examination-style questions and content in Braille, audio, large print, or coloured print versions, Alberta Education produces special-format practice tests for all subjects that have a diploma examination. Alberta schools with registered Alberta K–12 students may place orders for these tests. Braille versions are available in English and, by request, in French. All tests are provided free of charge, but limits may be placed on order volumes to ensure access for all students.

For the greatest benefit, special-format practice tests should be written under conditions similar to those of the corresponding diploma examination. The same rules regarding the use of resources and devices should be followed.

Braille versions must be returned to Alberta Education after use.

For more information or to place an order, contact

Laura LaFramboise
Distribution Coordinator, Examination Administration
780-492-1644
Laura.LaFramboise@gov.ab.ca
How to Get Involved

High-quality diploma examinations are the product of close collaboration between classroom teachers and Alberta Education. Classroom teachers from across Alberta are involved in many aspects of diploma examination development, including the development of items; the building, reviewing, administering, and marking of field tests; the reviewing and validating of diploma examinations; and the marking of diploma examinations.

The development of test items from when they are written until when they appear on an examination takes at least one year. All items on Biology 30 Diploma Examinations are written by Biology 30 teachers from across Alberta. After the first year of provincial implementation of the program of studies, items are field tested to ensure their reliability and validity. Diploma examinations are reviewed by editors; a technical advisory working group composed of science experts from post-secondary institutions, teachers, and curriculum staff; translators; and a French validation working group.

Alberta Education values the involvement of the teachers and annually asks school jurisdictions for the names of teachers who are interested in being involved in any of the development processes for diploma examinations. Teachers who are interested in developing items, constructing field tests, or reviewing and validating examinations are encouraged to talk to their principals about how they can submit their names for approval to be involved in these processes. Although the call for submissions occurs each fall, teachers are welcome to have their names submitted at any time.

Teachers may also be nominated by their school authority to mark written-response assignments for Humanities and Mathematics Diploma Examinations. The call for nominations occurs in early September (for January and April marking) and again in February (for June, August and November marking). Teachers who would like to be nominated to mark diploma exams are encouraged to talk to their principals.

Periodically, we send out information to those Biology 30 teachers who are on our contact list. If you are not on that list and would like to receive updates related to Biology 30 assessment activities, please contact either Shannon Mitchell, Biology 30 Exam Manager, at Shannon.Mitchell@gov.ab.ca or Claudine Coleman, Biology 30 Examiner, at Claudine.Coleman@gov.ab.ca.
Using Calculators

The Biology 30 Diploma Examination requires the use of a calculator that does not have prohibited properties, or graphing calculator approved by Alberta Education. The calculator directives, list of prohibited properties, criteria, and keystrokes for clearing approved graphing calculators are found in the General Information Bulletin.

Teachers should be aware of the capabilities of approved graphing calculators that are available when the calculator is not configured for exam purposes, as these capabilities may impact classroom instruction and assessment. These capabilities may also be applicable to other high school math and science courses.
Course Objectives

Biology 30 is intended to develop students’ understanding and application of biological concepts and skills. The focus of this course is on understanding the biological principles behind the natural events the students experience and the technology they use in their daily lives. Biology 30 is an experimental discipline that develops knowledge, skills, and attitudes to help students become capable of and committed to setting goals, making informed choices, and acting in ways that will improve their own lives as well as life in their communities.

Biology 30 students will develop their ability to observe, generalize, hypothesize, and infer through observation. They will show growth in their understanding of biological concepts by increasing their ability to apply these concepts to relevant situations and new contexts.

Throughout the course, students will continue to develop scientific literacy, and they will learn to communicate in the specialized language of biology.

Success in Biology 30 requires the successful completion of Science 10 and Biology 20, which develop the requisite knowledge and skills.

Program of Studies

The revised Biology 30 Program of Studies was implemented in September 2008, and the first diploma examination on the revised program was administered in January 2009. The program was updated in 2014 to include links to mathematics.

The program of studies is available online at education.alberta.ca.

Clarifications

Alberta Education receives questions and feedback from teachers and students by email, by phone, at working-group sessions, on field tests, and on perusal copies of diploma examinations. Comments and questions are both appreciated and encouraged. In response to the questions and feedback received, the following points clarify some aspects of the Biology 30 Diploma Examination.

• Outcome A2.3s refers to performing an experiment to investigate the presence of glucose in simulated urine and comparing the results with normal urinalysis data. Students who have completed this required skills outcome would have learned through the course of their experiment that no glucose is present in urine in a person with healthy glucose metabolism.

• Several outcomes (e.g., A2.3s, B2.3s, B3.3s) refer to analyzing data related to the concentrations of hormones and glucose in blood and urine. Others (e.g., A2.4s, B2.4s) refer to applying the conventions of science in communicating information. Students should therefore feel comfortable with units of concentration in general and should expect to see a variety of units used, as determined by the research or context presented.

• Outcome C1.2k refers to the events of the cell cycle, specifically interphase, mitosis, and cytokinesis. Students are not expected to know G1, S, or G2 of interphase. They should be aware that cytokinesis is considered to be part of mitosis. The cell cycle can be divided up in a number of different ways. Some resources show cytokinesis occurring during telophase.
and some show cytokinesis as a separate phase of mitosis, occurring after telophase. Both are acceptable.

- On diploma examinations, students are sometimes provided with information about genotypes or phenotypes of parents and asked to determine an aspect of the theoretical offspring. Students should assume that in these contexts provided as the basis for problem solving, the phrases two parents or a man and a woman refer to the biological, genetic parents of the theoretical offspring.

- Outcome C3.7k refers to mitochondrial DNA (mtDNA), which was always thought to have an exclusively maternal pattern of inheritance. In December 2018, Luo et al. published research in the Proceedings of the National Academy of Sciences of the United States of America (PNAS) suggesting some exceptional cases in which mtDNA seemed to be inherited from both parents. Since then, a series of rebuttals and responses to the original paper have been published, challenging the research methods, questioning the evidence, and proposing both alternative hypotheses and directions for further research.

  It is not appropriate to consider a finding from a single paper to be conclusively proving the paternal inheritance of mtDNA. The methods and findings must be reproduced and verified by multiple groups, multiple times, using multiple methods. For now, scientists consider the research to be interesting, yet inconclusive, and mtDNA is still considered to be maternally inherited only. The authors of the original paper themselves state that “the central dogma of maternal inheritance of mtDNA remains valid.”

  Teachers are not discouraged from discussing this research with their Biology 30 classes. It is, however, recommended that a discussion of the original paper also include the accompanying rebuttals and responses. Taken together, they provide an excellent example of the process of science working as it should within a Biology 30 context.

For a full listing of all the clarifications that have appeared over the last number of years, please see the archived bulletin.
Cognitive Expectations in the Program of Studies

Outcomes in the program of studies contain verbs that indicate the cognitive expectations of the outcome. Verbs typically classified under remembering/understanding (R/U) are coded yellow in the chart below; verbs typically classified under applying (A) are coded green; verbs typically classified as higher mental activities (HMA) are coded blue; and those relating to skills are coded pink.

The following graphic shows the same information arranged in a hierarchy, which is the arrangement used in the revised Bloom’s taxonomy.

The verbs arranged in the graphic shown above are only those that have been used in the Biology 30 Program of Studies. It is important to remember that the graphic should serve only as a guideline and that the verbs are not permanently fixed in the categories shown. A verb can indicate a variety of cognitive levels depending on the context in which it is used, and the two taken together are what determines the cognitive expectation.

Note that difficulty is independent of cognitive level. Outcomes at any of the three cognitive levels can be assessed at either the acceptable standard or the standard of excellence. Questions illustrating the updated cognitive-level categories appear at the end of this document.

Performance Expectations

Provincial performance standards help to communicate what students must be able to do to achieve the objectives specified in the Biology 30 Program of Studies. The specific statements of standards are written primarily to help Biology 30 teachers understand the extent to which students must know the required content and demonstrate the required skills in order to pass the examination.

Acceptable standard

Students who achieve the acceptable standard in Biology 30 will receive a final course mark of 50% or higher. Students who achieve the acceptable standard demonstrate a basic understanding of the nature of scientific inquiry by performing, observing, and interpreting simple investigations. They can readily interpret data that are represented in simple graphs and tables and can translate symbolic representations into written descriptions. These students are able to identify structures on diagrams and describe their functions, and they are able to recognize and provide definitions for simple biological terms. They demonstrate a basic understanding of equilibrium and the control of homeostasis in the human body. They solve simple, quantitative genetics and ecology problems. These students can apply their understanding of some key biological concepts and technologies to straightforward but novel contexts. They can interpret information in new contexts to identify scientific, technological, and societal components of biological issues.

Standard of excellence

Students who achieve the standard of excellence in Biology 30 will receive a final course mark of 80% or higher. In addition to meeting the expectations for the acceptable standard of performance, these students also demonstrate with confidence their aptitude and interest in biology. They design, analyze, and evaluate experimental designs. They readily interpret interrelated sets of data such as complex diagrams, graphs, and tables. These students provide specific and comprehensive explanations of concepts. They are able to integrate and apply their knowledge of biology to new and different contexts. They simultaneously apply two or more biological concepts that cross major themes. They demonstrate a thorough understanding of quantitative relationships and solve multistep numerical problems. They analyze complex and unique issues, including those related to current research. These students are aware of a variety of viewpoints relating to a variety of issues and perspectives in the field of science and technology.
Examination Specifications and Design

Each Biology 30 Diploma Examination is designed to reflect the general outcomes outlined in the Biology 30 Program of Studies and is blueprinted to the same specifications. The general outcomes are expressed in more detail by the specific outcomes, which are organized into four units. Some questions on each diploma examination will assess achievement of particular outcomes, and other questions will be based on the integration of more than one outcome.

<table>
<thead>
<tr>
<th>General Outcomes</th>
<th>Units of Study</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1, A2</td>
<td>Nervous and Endocrine Systems</td>
<td>20–25%</td>
</tr>
<tr>
<td></td>
<td>Students will explain how the nervous system controls physiological processes and how the endocrine system contributes to homeostasis.</td>
<td></td>
</tr>
<tr>
<td>B1, B2</td>
<td>Reproductive Systems and Hormones</td>
<td>10–15%</td>
</tr>
<tr>
<td></td>
<td>Students will explain how survival of the human species is ensured through reproduction and how human reproduction is regulated by chemical control systems.</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Differentiation and Development</td>
<td>5–10%</td>
</tr>
<tr>
<td></td>
<td>Students will explain how cell differentiation and development in the human organism are regulated by a combination of genetic, endocrine, and environmental factors.</td>
<td></td>
</tr>
<tr>
<td>C1, C2</td>
<td>Cell Division and Genetics</td>
<td>25–30%</td>
</tr>
<tr>
<td></td>
<td>Students will describe the processes of mitosis and meiosis and will explain the basic rules and processes associated with the transmission of genetic characteristics.</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Molecular Biology</td>
<td>10–15%</td>
</tr>
<tr>
<td></td>
<td>Students will explain classical genetics at the molecular level.</td>
<td></td>
</tr>
<tr>
<td>D1, D2, D3</td>
<td>Population and Community Dynamics</td>
<td>15–20%</td>
</tr>
<tr>
<td></td>
<td>Students will describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time; explain the interaction of individuals with one another and with members of other populations; and explain, in quantitative terms, the changes in populations over time.</td>
<td></td>
</tr>
</tbody>
</table>
Most of the examination questions are context-based. This means questions are organized into sets related to contexts associated with topics in the program of studies.

Context-based questions are necessary to assess the cognitive expectations of the program of studies. Students should expect to see some biological contexts that are completely new to them. They can be confident that the knowledge, skills, and attitudes they acquired in Biology 30 have prepared them to address these questions.

The diploma exam is composed of questions at all three cognitive levels (R/U, A, and HMA); however, the majority of the questions in the examination are at an applying (A) level of cognition, because that is what is required by the program of studies.

All contexts and questions are validated for correctness by scientists with academic expertise in the topics covered in the Biology 30 Program of Studies.

Context-based questions require reading. The number of words in a Biology 30 examination has been tracked over time. The number of words in the examination increased with the January 2010 diploma examination, which coincided with the removal of the written-response portion. Since January 2010, however, the number of words has remained consistent.

The order of questions in a diploma examination typically follows the order of units in the program of studies; however, a question could appear on the examination within another unit if the context relates to outcomes in more than one unit.

Questions that require skill in applying scientific processes and questions that require science, technology, and society (STS) connections are distributed throughout the examination.

The design of the 2019–2020 Biology 30 Diploma Examinations is as follows:

<table>
<thead>
<tr>
<th>Question Format</th>
<th>Number of Questions</th>
<th>Percentage Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Choice</td>
<td>48</td>
<td>80</td>
</tr>
<tr>
<td>Numerical Response</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

A particular context may be used for one or more multiple-choice questions; one or more numerical-response questions; or a combination of multiple-choice and numerical-response questions.

Multiple-choice questions are of two types: discrete and context dependent. A discrete question stands on its own without any additional directions or information. It may take the form of a question or an incomplete statement. A context-dependent question provides information that is separate from the question stem.

Most of the multiple-choice questions in the diploma examination are context dependent. If a context is provided on the diploma examination, then a student cannot properly address the question without reading the context. Students need to read contexts carefully.

Answers for multiple-choice questions are recorded in the first section of the machine-scored answer sheet.
**Numerical-response questions** are of several types, including these: calculating numerical values; expressing ratios; selecting structures, functions, or statements from a diagram or a list; matching structures, functions, or statements from a diagram or a list; and determining the sequence of listed events.

Specific instructions for recording answers for each type of numerical-response question are provided in the instructions pages of each *Biology 30 Diploma Examination* and with each question. Students are advised to pay close attention to specific instructions included with each question for recording answers on the answer sheet.

Answers for numerical-response questions are recorded in the second section of the machine-scored answer sheet.
Trends in Student Performance

On the June 2018 and January 2019 Biology 30 Diploma Examinations, students showed that they are very good at addressing questions requiring them to demonstrate basic knowledge of biology. Some students were challenged by questions requiring them to apply their acquired knowledge to new contexts, and others had difficulty with questions requiring them to integrate concepts across units. The vast majority of students were skilled at interpreting contexts related to experimental design, including describing hypotheses, identifying variables, and drawing conclusions from data.

What follows are descriptions of students’ performance as demonstrated by their achievement on the June 2018 and January 2019 diploma examinations. Areas of strength and areas of difficulty are described in point form, grouped broadly by topic into rows. The most common errors are described when they are apparent. The descriptions of errors appear in italicized text in the third column to emphasize that they reflect incorrect biology.
## Unit A: Nervous and Endocrine Systems

<table>
<thead>
<tr>
<th>Areas of Strength</th>
<th>Areas of Difficulty</th>
<th>Most Common Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identifying structures of a neuron on diagrams and by descriptions of their functions</td>
<td>• Differentiating the central and peripheral nervous systems</td>
<td>• Some students confused dendrites and axon terminals in a diagram of the neuron.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Identifying effects of the parasympathetic nervous system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Identifying structures of the synapse on diagrams and by their descriptions</td>
<td>• Hypothesizing how an external factor affecting the amount of neurotransmitter present would alter synaptic transmission</td>
</tr>
<tr>
<td></td>
<td>• Interpreting contexts related to the basic functioning of the synapse and the general role of neurotransmitters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Applying knowledge of depolarization to a new context</td>
<td>• Explaining depolarization in terms of the events occurring in the neuron membrane and how external factors could alter those events</td>
</tr>
<tr>
<td></td>
<td>• Differentiating between depolarization, repolarization, and hyperpolarization</td>
<td></td>
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<tr>
<td></td>
<td>• Interpreting diagrams of reflex arcs and identifying roles of some of the parts, especially the sensory neuron and motor neuron</td>
<td>• Describing the role of the interneuron in a reflex arc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some students thought that action potentials travel from the motor neuron to the interneuron in a reflex arc.</td>
</tr>
<tr>
<td></td>
<td>• Interpreting a new context to identify on a diagram the part of the brain affected</td>
<td>• Interpreting contexts related to the brain to identify the names of the parts of the brain affected</td>
</tr>
<tr>
<td></td>
<td>• Describing the functions of the frontal and occipital lobes of the brain</td>
<td></td>
</tr>
<tr>
<td>Areas of Strength</td>
<td>Areas of Difficulty</td>
<td>Most Common Errors</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| • Interpreting diagrams of the eye, identifying structures, and describing their functions  
• Interpreting contexts related to diseases of the eye and their treatments to determine the effect on the eye  
• Differentiating the functions of rods and cones  
• Understanding the role of hair cells in hearing | • Identifying similarities between organisms that use hair cells to generate nerve impulses and human senses  
• Comparing the role of hair cells in hearing and in maintaining equilibrium | • Some students thought that aldosterone is secreted by the pituitary gland.  
• Some students thought that insulin and glucagon are regulated by pituitary hormones. |
| • Identifying the names and locations of glands that secrete hormones  
• Identifying the functions of most hormones | • Choosing from a list of hormones all those that are secreted by the pituitary gland  
• Differentiating the functions of ADH and aldosterone | |
### Areas of Strength
- Interpreting contexts to predict changes in hormone secretion
- Interpreting contexts to predict the regulation of hormone secretion through negative feedback, especially those involving TSH and thyroxine
- Differentiating the functions of cortisol and epinephrine
- Understanding the relationship between PTH and blood-calcium level
- Demonstrating understanding that type 1 diabetes mellitus results from an insufficiency of insulin
- Interpreting contexts to determine physiological reasons for the presence of glucose in urine

### Areas of Difficulty
- Understanding the relationship between ACTH, cortisol and blood-glucose level
- Understanding how various hormones involved in glucose metabolism affect blood-glucose levels
- Understanding how physiological symptoms could have resulted from imbalances in ADH and aldosterone
- Understanding the ultimate effect of PTH on bones
- Understanding the specific effect of glucagon on blood-glucose level

### Most Common Errors
- Some students thought that ACTH stimulates the release of insulin.

- Interpreting a context related to an experiment and describing the control group
- Interpreting a context related to results of a medical test and drawing conclusions from the data
## Unit B: Reproduction and Development

<table>
<thead>
<tr>
<th>Areas of Strength</th>
<th>Areas of Difficulty</th>
<th>Most Common Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identifying structures of the male and female reproductive systems</td>
<td>• Differentiating the seminal vesicle, Cowper's gland, and prostate gland in diagrams</td>
<td>• Some students thought that vasa deferentia have an effect on the volume of seminal fluid produced.</td>
</tr>
<tr>
<td>• Describing the functions of structures in the male and female reproductive systems</td>
<td>• Differentiating the functions of the seminal vesicle, Cowper's gland, and prostate gland</td>
<td>• Some students identified Sertoli cells as interstitial cells and vice versa in a cross section of a testis.</td>
</tr>
<tr>
<td>• Identifying structures in a cross section of seminiferous tubules and a cross section of an ovary</td>
<td>• Differentiating developing sperm from surrounding structures</td>
<td>• Some students identified the ovum as the follicle and vice versa on a cross section of an ovary.</td>
</tr>
<tr>
<td>• Identifying the functions of reproductive hormones</td>
<td>• Interpreting a context describing a change in GnRH secretion and determining effects on estrogen and progesterone</td>
<td></td>
</tr>
<tr>
<td>• Interpreting a context related to LH and FSH and determining the effects of altering the secretion of these hormones</td>
<td>• Integrating new information with their knowledge of FSH regulation to determine the order in which events occur</td>
<td></td>
</tr>
<tr>
<td>• Understanding the relationship between LH, interstitial cells, and testosterone, including regulation through negative feedback</td>
<td>• Integrating a new context related to reproductive technologies with their knowledge of the menstrual cycle</td>
<td></td>
</tr>
<tr>
<td>• Understanding the secretion of hormones during the menstrual cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Understanding the negative-feedback effects of ovarian hormones on pituitary hormones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas of Strength</td>
<td>Areas of Difficulty</td>
<td>Most Common Errors</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>• Understanding the role of testosterone in sex determination during human</td>
<td>• Describing gastrulation</td>
<td>• Some students thought that gastrulation describes the development of germ layers and organs.</td>
</tr>
<tr>
<td>development</td>
<td>• Identifying structures that arise from embryonic germ layers</td>
<td></td>
</tr>
<tr>
<td>• Interpreting a diagram of a blastocyst</td>
<td>• Differentiating the placenta from other embryonic structures on a diagram</td>
<td>• Some students identified the outer cells of the blastocyst as the ectoderm.</td>
</tr>
<tr>
<td>• Interpreting a context to determine the time of development when twins were</td>
<td>• Describing the secretory function of the placenta</td>
<td></td>
</tr>
<tr>
<td>formed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting contexts to determine specifically how STIs affect fertility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Unit C: Cell Division, Genetics, and Molecular Biology

<table>
<thead>
<tr>
<th>Areas of Strength</th>
<th>Areas of Difficulty</th>
<th>Most Common Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interpreting a context related to cell division in humans to determine ploidy of cells</td>
<td>• Determining the chromosome number of somatic cells that result from the combination of two gametes, one of which has been produced by nondisjunction</td>
<td>• Some students identified interphase as a sub-phase of mitosis.</td>
</tr>
<tr>
<td>• Interpreting karyotypes to identify a chromosomal disorder and sex of the cells</td>
<td>• Interpreting a life cycle to determine ploidy or the number of chromosomes in a structure</td>
<td>• Some students thought that in humans, mitosis begins with haploid cells.</td>
</tr>
<tr>
<td></td>
<td>• Applying knowledge of karyotyping to a life cycle to predict the arrangement of chromosomes of a structure in the life cycle</td>
<td>• Some students thought that in humans, mitosis results in the production of haploid cells.</td>
</tr>
<tr>
<td></td>
<td>• Interpreting diagrams of the cell cycle to identify interphase and phases of mitosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Identifying events in the cell cycle that correspond to parts of a diagram of the cell cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Differentiating diagrams of metaphase I and II by the appearance of chromosomes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Comparing and contrasting spermatogenesis and oogenesis</td>
<td></td>
</tr>
<tr>
<td>• Identifying phases of meiosis and the events that take place during those phases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting diagrams of cells in meiosis to identify a phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Identifying the point in a life cycle when meiosis takes place</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas of Strength</td>
<td>Areas of Difficulty</td>
<td>Most Common Errors</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>• Interpreting new contexts and diagrams related to the formation of twins</td>
<td>• Relating patterns of inheritance to descriptions of how alleles are inherited</td>
<td>• Some students identified an unaffected individual as being homozygous dominant rather than homozygous recessive in autosomal dominant inheritance.</td>
</tr>
<tr>
<td>• Differentiating the formation of identical and fraternal twins</td>
<td>• Calculating probability when combining codominant and autosomal recessive traits in a dihybrid cross</td>
<td></td>
</tr>
<tr>
<td>• Relating Mendel's principle of dominance to ploidy within a new context</td>
<td>• Calculating probability based on information in a pedigree</td>
<td></td>
</tr>
<tr>
<td>• Working with many different types of genetics contexts and symbols to solve simple and complex genetics problems</td>
<td>• Choosing a pedigree that illustrates a described pattern of inheritance</td>
<td>• Some students did not draw a chromosome map in order to determine the behaviour of two genes on the chromosome; instead, they made assumptions based on data in a table alone.</td>
</tr>
<tr>
<td>• Calculating ratios and probabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Determining genotypes and phenotypes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Combining different types of inheritance (e.g., autosomal alleles, X-linked alleles, gene interaction, codominance, and multiple alleles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting pedigrees and evaluating them for correctness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting chromosome maps and calculating map distances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas of Strength</td>
<td>Areas of Difficulty</td>
<td>Most Common Errors</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>• Identifying features of Watson and Crick’s model of DNA</td>
<td>• Determining the change in amino acid sequence given both the unmutated and mutated DNA triplets</td>
<td>• Students used the mRNA codon chart for a DNA triplet instead of first transcribing the DNA sequence.</td>
</tr>
<tr>
<td>• Understanding the structure of DNA</td>
<td>• Determining DNA sequence from a mRNA sequence</td>
<td></td>
</tr>
<tr>
<td>• Interpreting diagrams showing transcription and translation</td>
<td>• Determining anticodons on tRNA</td>
<td></td>
</tr>
<tr>
<td>• Determining an mRNA sequence from a DNA sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Determining amino acid sequences from gene sequences, including those illustrating mutations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Understanding the roles of restriction enzymes and ligase, and applying their knowledge to new contexts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Unit D: Population and Community Dynamics

<table>
<thead>
<tr>
<th>Areas of Strength</th>
<th>Areas of Difficulty</th>
<th>Most Common Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Understanding factors affecting genetic diversity in a population, especially the founder effect, the bottleneck effect, and natural selection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Relating variables in the Hardy–Weinberg equation to genotypes</td>
<td>• Using a frequency to calculate the number of individuals in a population expected to have a particular genotype</td>
<td></td>
</tr>
<tr>
<td>• Calculating frequencies requiring one or two steps</td>
<td>• Using data to determine the proportion of a population that is heterozygous for a trait</td>
<td></td>
</tr>
<tr>
<td>• Comparing frequencies of a trait in different populations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting contexts to identify symbiotic relationships and types of competition between organisms</td>
<td>• Describing how changes in a community affect the environmental resistance exerted on a population</td>
<td></td>
</tr>
<tr>
<td>• Interpreting contexts related to ecological succession to differentiate between primary and secondary succession</td>
<td>• Classifying species as being pioneer or climax species</td>
<td></td>
</tr>
<tr>
<td>• Understanding how natality, mortality, and immigration affect population growth</td>
<td>• Calculating per capita growth rate ((cgr))</td>
<td>• Students divided by the final population rather than the initial population when calculating (cgr).</td>
</tr>
<tr>
<td>• Calculating growth rate ((gr))</td>
<td></td>
<td>• Some students identified defence mechanisms and migration as aspects of a reproductive strategy (K-selection or r-selection).</td>
</tr>
<tr>
<td>• Determining whether (gr) and (cgr) are positive or negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Calculating population density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Interpreting a context to identify a population’s reproductive strategy and growth pattern</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment of STS Outcomes

Examination questions assess students’ understanding of biological concepts in the program of studies. Some questions have been designed to assess students’ understanding of the interrelationships between science and technology, as well as between science, technology, and society. Some STS outcomes are not as easily assessed on a machine-scored examination as others. The assumption is made that teachers are carrying out assessments and observations of STS outcomes with their students throughout the course. The appearance of questions on the diploma examination that assess STS outcomes should be expected.

The Biology 30 Program of Studies contains only 10 different STS outcomes, some of which are repeated in more than one unit.

Assessment of Skills Outcomes

Examination questions assess students’ understanding of biological concepts in the program of studies. Some questions also assess students’ development of the skills and thinking processes associated with scientific inquiry. Some skills outcomes are not as easily assessed on a machine-scored examination as others. The assumption is made that teachers are carrying out assessments and observations of skills outcomes with their students throughout the course. The development of skills outcomes is mandated by the program of studies, and, therefore, the appearance of questions on the diploma examination that assess these skills should be expected. Teachers are encouraged to consult the program of studies for a complete description of skills outcomes.

Assessment Standards

A document that describes standards of achievement appropriate to the Biology 30 Program of Studies was updated in 2018 and can be found on the Alberta Education website. The assessment standards document provides examples of some behaviours exhibited by students at the acceptable standard and at the standard of excellence. It should be used in conjunction with the program of studies, as it is not intended to replace the program of studies. The Student-based Performance Standards document is posted on the Alberta Education website.

Assessment Exemplars

A document of Biology 30 assessment exemplars was updated in 2016. The assessment exemplars include multiple-choice and numerical-response questions and are posted on the Alberta Education website.
Biology Instructions Pages

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November 2019

Biology 30

Grade 12 Diploma Examination

Description

Time: 3 hours. This closed-book examination was developed to be completed in 3 hours; however, you may take up to 6 hours to complete the examination, should you need it.

This examination consists of 48 multiple-choice and 12 numerical-response questions, of equal value.

This examination contains sets of related questions. A set of questions may contain multiple-choice and/or numerical-response questions.

Tear-out data pages are included near the back of this booklet.

Instructions

• Turn to the last page of the examination booklet. Carefully fold and tear out the machine-scored answer sheet along the perforation.

Note: Additional tear-out pages at the back of this booklet may be used for your rough work. No marks will be given for work done on the tear-out pages.

• Use only an HB pencil for the answer sheet.

• Fill in the information on the back cover of the examination booklet and the answer sheet as directed by the presiding examiner.

• You are expected to provide your own calculator. You may use any scientific calculator that does not have prohibited properties or graphing calculator approved by Alberta Education.

• You must have cleared your calculator of all information that is stored in the programmable or parametric memory.

• You may use a ruler and a protractor.

• Read each question carefully.

• Consider all numbers used in the examination to be the result of a measurement or an observation.

• If you wish to change an answer, erase all traces of your first answer.

• Do not fold the answer sheet.

• The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.

• Now read the detailed instructions for answering machine-scored questions.

Note: Additional tear-out pages at the back of this booklet may be used for your rough work. No marks will be given for work done on the tear-out pages.
**Multiple Choice**

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

**Example**

This examination is for the subject of

A. chemistry
B. biology
C. physics
D. science

Answer: B

**Numerical Response**

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- Enter the first digit of your answer in the left-hand box. Any boxes on the right that are not needed are to remain blank.

**Examples**

**Calculation Question and Solution**

The average of the values 21.0, 25.5, and 24.5 is __________.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Answer: 23.7

---

**Record B on the answer sheet:**  A  ●  ○  ○
Sequencing Question and Solution

Four Subjects

1. Physics
2. Biology
3. Science
4. Chemistry

When the subjects above are arranged in alphabetical order, their order is ____, ____, ____, and ____.

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Answer: 2413

Selection Question and Solution

Five Subjects

1. Art
2. Music
3. Physics
4. Biology
5. Chemistry

The science subjects in the list above are numbered ____, ____, and ____.

(Record all three digits of your answer in any order in the numerical-response section on the answer sheet.)

Answer: 345

Note: All answers containing only the three digits 3, 4, and 5, in any order, will be scored as correct.
**Ratio Question and Solution**

A collection of marbles includes eight green marbles, four blue marbles, and two white marbles.

What is the colour ratio of the marbles in the collection?

**Ratio:** \( \square : \square : \square \)

**Colour:** Green Blue White

(Record all three digits of your answer in the numerical-response section on the answer sheet.)

**Answer:** 421

Record 421 on the answer sheet

Fill in the corresponding circles

**Multiple-answer Matching Question and Solution**

<table>
<thead>
<tr>
<th>Continent</th>
<th>Country</th>
<th>Capital City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 North America</td>
<td>4 France</td>
<td>7 Beijing</td>
</tr>
<tr>
<td>2 Europe</td>
<td>5 China</td>
<td>8 Ottawa</td>
</tr>
<tr>
<td>3 Asia</td>
<td>6 Canada</td>
<td>9 Paris</td>
</tr>
</tbody>
</table>

Using the numbers above, choose one continent and match it with a country in that continent and with that country’s capital city. (There is more than one correct answer.)

**Number:**

(Record all three digits of your answer in the numerical-response section on the answer sheet.)

**Answer:** 168 or 249 or 357

Record 168 on the answer sheet

Fill in the corresponding circles

**Note:** The answers 168, 249, or 357 will be scored as correct.
Biology Data Pages

Biology tear-out data pages are included at the back of the diploma examination booklet. These data pages are available on the Alberta Education website.

Biology 30 Data Booklet available on education.alberta.ca

Students should be familiar with the data pages before writing the diploma examination.
Publications and Supporting Documents

The following documents are published by Alberta Education:

*Biology 30 Information Bulletin* updated version available by August prior to the beginning of each school year

*Biology 30 Archived Bulletin* updated version available by August prior to the beginning of each school year

*Biology 30 Student-based Performance Standards* updated in fall 2018

*Biology 30 Released Materials* most recent version published in fall 2019 which consists of items from the November 2018 Diploma Examination

*Biology 30 Exemplars* updated in fall 2016

Diploma exam results
Preparation Materials for Students

Materials that could help students prepare for the Biology 30 Diploma Examination include the following:

*Guide for Students*

*Biology Data Booklet*

*Biology 30 Released Items*

*Biology 30 Student-based Performance Standards*

*Biology 30 Exemplars*

*Online Practice Tests – Biology 30.* The year-end practice test, 2007 Released Items, 2009 Released Items, 2011 field-tested items, and 2014 Released Items available on Quest A+ include a formative element. Students can click on a button to view information explaining why an alternative is correct or incorrect. They can also view the cognitive level that corresponds to a particular question.
Biology 30 Field Testing

In Biology 30, year-end field tests are offered in both digital and hybrid formats.

Year-end field tests are available in two different lengths: one that takes 50 minutes of writing time, and one that takes 65 minutes of writing time. (Students are allowed an extra 15 minutes of writing time if it is available.)

An additional 10 minutes of administration time is required for each field-test administration period. Therefore, a class in which a Biology 30 field test is to be administered should be a minimum of 60 minutes.

If your class blocks are shorter than 60 minutes but you would like your students to participate in field testing, you can still request a field test if arrangements can be made in the school to provide students with an appropriate time period for the purposes of field testing.

Field tests can be scheduled either within class time or outside of class time up to two days in advance of the Biology 30 Diploma Examination.

For more information on requesting field tests, please refer to the Field Testing section of the General Information Bulletin.
Sample Questions Illustrating Cognitive Level

This section contains examples of questions that illustrate different cognitive levels.

**Remembering/Understanding (R/U) Level**

Olfaction is the sense that enables organisms to distinguish and interpret odours. An action potential is initiated when a chemical interacts with an odour-receptor protein in the cell membrane of a sensory neuron in the nasal cavity.

The area of the brain where odours are interpreted is the

A. cerebrum
B. cerebellum
C. hypothalamus
D. medulla oblongata

Answer: A
Outcome: A1.2k
Cognitive level: R/U (remembering)
Regulation of Reproductive Hormones in Humans

Which of the following rows identifies Gland 1, Gland 2, Hormone X, and Hormone Y, as shown in the diagram above?

<table>
<thead>
<tr>
<th>Row</th>
<th>Gland 1</th>
<th>Gland 2</th>
<th>Hormone X</th>
<th>Hormone Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Pituitary gland</td>
<td>Hypothalamus</td>
<td>LH</td>
<td>GnRH</td>
</tr>
<tr>
<td>B.</td>
<td>Hypothalamus</td>
<td>Pituitary gland</td>
<td>GnRH</td>
<td>LH</td>
</tr>
<tr>
<td>C.</td>
<td>Hypothalamus</td>
<td>Pituitary gland</td>
<td>GnRH</td>
<td>FSH</td>
</tr>
<tr>
<td>D.</td>
<td>Pituitary gland</td>
<td>Hypothalamus</td>
<td>FSH</td>
<td>GnRH</td>
</tr>
</tbody>
</table>

Answer: B
Outcomes: B2.3k, B2.1k
Cognitive level: R/U (understanding)
### Applying (A) Level

<table>
<thead>
<tr>
<th>Ecological Relationship</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Predator–prey</td>
<td>An interaction where members of the same species compete for the same resources.</td>
<td>Aggressive salamanders are more successful at obtaining food compared to less aggressive salamanders.</td>
</tr>
<tr>
<td>2 Interspecific Competition</td>
<td>A relationship in which an organism kills and consumes another organism.</td>
<td>Squirrels and chipmunks compete for acorns.</td>
</tr>
<tr>
<td>3 Intraspecific Competition</td>
<td>An interaction where members of different species compete for the same resources.</td>
<td>A female lion hunts and captures a zebra and brings the food back to its pride.</td>
</tr>
</tbody>
</table>

**Numerical Response**

Using the numbers above, choose one ecological relationship and match it with the definition associated with that ecological relationship and with an example that represents both the definition and the ecological relationship. (There is more than one correct answer.)

Ecological relationship:  
Definition:  
Example:  

(Record all three digits of your answer in the response boxes at the bottom of the screen.)

Answer: 159, 268, 347
Outcomes: D2.1k
Cognitive level: A
The eumelanin gene determines coat colour in dogs. The dominant allele \((E)\) produces a black coat, and the recessive allele \((e)\) produces a red coat. The merle gene controls the expression of colour. The merle alleles are incompletely dominant, as shown below.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mm)</td>
<td>Full colour (either black or dark red)</td>
</tr>
<tr>
<td>(Mm)</td>
<td>Dilute colour (either grey or light red)</td>
</tr>
<tr>
<td>(MM)</td>
<td>White</td>
</tr>
</tbody>
</table>

The eumelanin and merle genes are located on two different autosomes.

A grey dog that is homozygous dominant for eumelanin mates with a dark red dog. The phenotypes that are possible in their offspring are

A. grey and black
B. black and white
C. grey and dark red
D. dark red and black

Answer: A
Outcomes: C2.2k, C2.3s
Cognitive level: A
A mutation in the connexin 26 gene involves the deletion of two bases and their replacement by two new bases. The deletion is shown below.

\[\text{ATC}\]

The two deleted bases are replaced by two adenine bases.

—based on Human Gene Mutation Database, 2010

The transcription of the mutated connexin 26 gene described above results in the replacement of a

A. stop codon with a lysine codon  
B. methionine codon with a lysine codon  
C. stop codon with a phenylalanine codon  
D. methionine codon with a phenylalanine codon

Answer: C  
Outcomes: C3.6k, C3.3k, and C3.2s  
Cognitive level: A
A contraceptive implant has been developed for male dogs. The implant releases a drug called deslorelin.

**Some Statements Related to the Use of Deslorelin**

1. Administering deslorelin for a short period of time costs less than neutering a male dog.
2. Researchers hypothesize that deslorelin could be used to control the populations of some wild animals.
3. Veterinarians are concerned that the manipulation of hormones with deslorelin will increase the incidence of cancer in dogs.
4. Using deslorelin to decrease reproduction in dogs could decrease the need for organizations like the SPCA and other humane organizations.

**Numerical Response**

Match each statement related to the use of deslorelin with the consideration that describes it given below.

<table>
<thead>
<tr>
<th>Statement:</th>
<th>Consideration:</th>
<th>Societal</th>
<th>Technological</th>
<th>Economic</th>
<th>Ecological</th>
</tr>
</thead>
</table>

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Answer: 4312
Outcomes: B3.5k and B2.2sts
Cognitive level: A
The Venn diagram below shows the relationship between oogenesis and spermatogenesis.

**Numerical Response**

Match the numbered regions of the Venn diagram with the descriptions below. (A number may be used more than once.)

<table>
<thead>
<tr>
<th>Number:</th>
<th>Description:</th>
<th>Four daughter cells produced</th>
<th>Unequal cytoplasmic division</th>
<th>Stimulated by FSH</th>
<th>Daughter cells equal in size</th>
</tr>
</thead>
</table>

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Answer: 2123 or 3123
Outcomes: C1.3k
Cognitive level: A
Adult butterflies are diploid. The sex chromosomes in adult female butterflies are W and Z chromosomes, whereas the sex chromosomes in adult male butterflies are two Z chromosomes.

**Life Cycle of a Butterfly**

A karyotype of Structure 1 in the diagram above would have

A. two copies of each autosome and two Z chromosomes  
B. one copy of each autosome and either a W or a Z chromosome  
C. one copy of each autosome, a W chromosome, and a Z chromosome  
D. two copies of each autosome, a W chromosome, and a Z chromosome

Answer: B  
Outcomes: C1.7k and C1.3s  
Cognitive level: HMA (analyzing)
Dentinogenesis imperfecta is a condition associated with thin tooth enamel and discoloured teeth. A student used the pedigree below to identify the mode of inheritance of dentinogenesis imperfecta. The student determines that dentinogenesis imperfecta is inherited in an autosomal recessive pattern.

A Pedigree Showing the Inheritance of Dentinogenesis Imperfecta

Which of the following rows best evaluates the correctness of the student’s identification of the pattern of inheritance displayed in the pedigree and explains why?

<table>
<thead>
<tr>
<th>Row</th>
<th>Evaluates</th>
<th>Explains</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Correct</td>
<td>Pattern is autosomal recessive, because individual I-1 is a carrier and has an unaffected child</td>
</tr>
<tr>
<td>B.</td>
<td>Incorrect</td>
<td>Pattern should be X-linked recessive, because individual II-7 passes the condition on to his son</td>
</tr>
<tr>
<td>C.</td>
<td>Incorrect</td>
<td>Pattern should be X-linked dominant, because individual I-2 passes the condition on to her daughter</td>
</tr>
<tr>
<td>D.</td>
<td>Incorrect</td>
<td>Pattern should be autosomal dominant, because individuals II-3 and II-4 have an unaffected child</td>
</tr>
</tbody>
</table>

Answer: D
Outcomes: C2.2k and C2.3s
Cognitive level: HMA (evaluating)
Website Links

education.alberta.ca

Programs of Study

General Information Bulletin
contains specific directives, guidelines, and procedures of diploma examinations

Diploma Examinations Program

Writing Diploma Examinations
contains Guides for Students, exemplars, and other support documents

Quest A+
contains practice questions and questions from previous diploma examinations

Field Test Request System

Field-test Information

School Reports and Instructional Group Reports
contain detailed statistical information on provincial, group, and individual student performance on the entire examination
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Inquiries about field testing can be sent by email to field.test@gov.ab.ca

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