Information Bulletin

Biology 30

Diploma Examinations Program

Archived Information

Alberta Education

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Contents

Assessment Standards

The following document describes standards of achievement appropriate to the Biology 30 Program of Studies, as developed by teachers from across Alberta in co-operation with Learner Assessment, Alberta Education. This information is not intended to replace the Program of Studies.

Biology 30 Assessment Standards

General Outcome A1: Students will explain how the nervous system controls physiological processes

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• outline the organization of the nervous system, including the CNS, PNS, somatic system, and autonomic system	• describe the organization of the peripheral nervous system in terms of motor, sensory-somatic, sympathetic, and parasympathetic pathways
• identify the cell body, dendrite, axon, Schwann cell, myelin sheath, node of Ranvier, and synaptic knob of a neuron on a diagram	• identify the cell body, dendrite, axon, Schwann cell, myelin sheath, node of Ranvier, and synaptic knob of a neuron on a prepared slide or photomicrograph
• sketch and label a diagram of a neuron	
• describe the function of the cell body, dendrite, axon, Schwann cell, myelin sheath, node of Ranvier, and synaptic knob of a neuron	
• explain the relationship between the myelin sheath and nerve impulse transmission	• explain that some axons are able to be repaired after being damaged
• identify a sensory neuron, a motor neuron, and an interneuron on a diagram	• identify a sensory neuron, a motor neuron, and an interneuron on a prepared slide or photomicrograph
• compare the function of sensory neurons, motor neurons, and interneurons	• compare the structure of sensory neurons, motor neurons, and interneurons
• describe the all-or-none characteristic and threshold potential of a nerve impulse	• relate types of stimuli and threshold levels to action potentials and to intensity of responses (summation)
• define an action potential and a refractory period	• sketch and label a graph of the polarity of a neuron membrane during the transmission of a nerve impulse, including the resting potential, action potential, and refractory period
• describe the movement of sodium and potassium ions during polarization, depolarization, and repolarization of a neuron	• explain the role of ion channels and sodium-potassium pumps in the establishment of the resting potential and the action potential
• describe a synapse and explain how acetylcholine is used to transmit a signal across the synapse	• recognize that other chemicals act as neurotransmitters (i.e., norepinephrine, dopamine, and serotonin)
• recognize that neurotransmitters can be excitatory or inhibitory	• describe hyperpolarization in terms of its inhibitory effect on a neuron
• describe the role of cholinesterase in regulating synaptic transmission	• infer from data the effects of common stimulants, depressants, or other chemicals on excitatory and inhibitory responses of neurons

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• identify the cerebrum, lobes of the cerebrum, cerebellum, pons, medulla oblongata, hypothalamus, and spinal cord using models, computer simulations, dissections, or diagrams of the brain • sketch and label a diagram of the brain • describe the functions of the lobes of the cerebrum, cerebellum, pons, medulla oblongata, hypothalamus, and spinal cord • explain the homeostatic function of the autonomic nervous system and compare the roles of the sympathetic and parasympathetic systems • relate the location of myelinated and unmyelinated nerve fibres to white and grey matter within the central nervous system • describe the organization of neurons into nerves • describe the composition and function of a reflex arc	• identify the motor cortex and sensory cortex on a model or diagram of the brain
• perform an experiment to investigate a reflex arc • describe the function of the human eye and its structures, including the sclera, cornea, iris, pupil, lens, choroid, ciliary muscle, retina, rods and cones, fovea centralis, optic nerve, and blind spot • explain how the structures of the eye function to form a retinal image • trace the pathway of light from the eye to the area of the brain where the interpretation of light stimuli occurs	• design an experiment to investigate a reflex arc • perform an experiment to measure an individual's ability to visually discriminate objects
• describe the function of the human ear and its structures, including the pinna, auditory canal, tympanum, ossicles, cochlea, organ of Corti, auditory nerve, semicircular canals, and Eustachian tube	• perform an experiment to measure an individual's ability to hear a range of sounds
• trace the pathway of sound from the ear to the area of the brain where the interpretation of sound stimuli occurs • identify other ways that humans sense their environment, such as the sensations of touch, temperature, taste, olfaction, and proprioception	• explain how the structures of the ear initiate impulses that stimulate both auditory and balance centres in the brain • explain other ways that humans sense their environment, such as the sensations of touch, temperature, taste, olfaction, and proprioception • explain the roles of the eye, the ear, and proprioceptors in spatial orientation • design an experiment to measure an individual's ability to sense touch, temperature, taste, or smell

General Outcome A2: Students will explain how the endocrine system contributes to homeostasis

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• describe the general function of an endocrine gland	
• identify in diagrams and models the principal endocrine structures of humans, including the hypothalamus, pituitary gland, thyroid gland, parathyroid glands, adrenal glands, and the pancreatic islet cells	• describe the relationship between the hypothalamus and pituitary gland
• identify the source and describe the function of thyroid stimulating hormone (TSH), thyroxine, calcitonin, parathyroid hormone (PTH), adrenocorticotropic hormone (ACTH), cortisol, insulin, glucagon, human growth hormone (hGH), antidiuretic hormone (ADH), epinephrine, and aldosterone	• infer, through the analysis and interpretation of data, the role of a hormone in regulating the internal environment
• describe how hormones maintain homeostasis through negative feedback	• illustrate negative feedback control of hormonal secretion
• explain the roles of thyroxine in metabolism; insulin, glucagon, and cortisol in blood glucose metabolism; hGH in growth; ADH in water regulation; aldosterone in sodium ion regulation; and PTH and calcitonin in calcium ion regulation	• analyze and interpret data on blood and urine composition to infer the role of insulin in the maintenance of glucose in the blood
	• analyze and interpret data on blood and urine composition to infer the role of ADH and aldosterone in the maintenance of water and ions in the blood
• using a specific example, explain how the endocrine system allows humans to sense their internal environment and respond appropriately	• compare the endocrine and nervous control systems and explain how they act together
• describe the physiological consequences of hormone imbalance in a person with diabetes mellitus	• describe the physiological consequences of a hormone imbalance when given information on a particular disorder • evaluate the use of hormone therapy as a medical treatment • formulate a hypothesis from published data on the influence of environmental factors on the endocrine system

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General Outcome B1: Students will explain how survival of the human species is ensured through reproduction

A student achieving the *acceptable standard* can:

- describe the structure and function of the female reproductive system, including the ovaries, Fallopian tubes, uterus, endometrium, cervix, and vagina
- describe the structure and function of the male reproductive system, including the testes, seminiferous tubules, interstitial cells, Sertoli cells, epididymides (*singular* epididymis), vasa deferentia (*singular* vas deferens), Cowper's glands, seminal vesicles, prostate gland, ejaculatory duct, urethra, and penis
- identify female and male reproductive organs in diagrams and models
- identify the nucleus, acrosome, mitochondria, and flagellum of a sperm, and describe their functions
- compare the structure and function of the egg (ovum) and sperm

- describe the composition of semen
- describe the pathway that sperm follows through the male reproductive tract
- identify the chromosomal composition of the zygote that determines gonad development in an embryo and fetus

A student achieving the *standard of excellence* can:

- distinguish eggs (ova) from their related structures (i.e., follicle, corpus luteum) on a diagram, prepared slide, or photomicrograph of ovaries
- distinguish sperm from their related structures (i.e., interstitial cells, Sertoli cells, seminiferous tubules) on a diagram, prepared slide, or photomicrograph of testes

- describe the role of the Y chromosome and testosterone in the determination of sex characteristics in an embryo and fetus
- explain how sexually transmitted infections (STIs) can interfere with fertility and reproduction
- evaluate practical solutions to decreased fertility (e.g., low sperm count, difficulty producing eggs, hormonal imbalances)

General Outcome B2: Students will explain how human reproduction is regulated by chemical control systems

A student achieving the *acceptable standard* can:

- define and describe primary and secondary sex characteristics
- identify the hormones that stimulate the development of secondary sex characteristics in males and in females
- describe the role of hormones related to reproduction, including GnRH, FSH, LH, testosterone, estrogen, and progesterone
- describe the interactions of FSH, LH, and testosterone in the maintenance and functioning of the male reproductive system
- describe negative feedback control of the secretion of estrogen, progesterone, and testosterone
- describe the interactions of FSH, LH, estrogen, and progesterone in the maintenance of the menstrual cycle
- define menstruation
- describe the changes that occur in the ovary and uterus during a single menstrual cycle
- describe how hormones secreted by the follicle and corpus luteum regulate development of the endometrium

A student achieving the *standard of excellence* can:

- describe how the hypothalamus, pituitary gland, and testes or ovaries stimulate the development of male or female secondary sex characteristics in males and in females
- analyze blood hormone data and physiological events to infer the roles of male sex hormones
- describe the positive feedback of high levels of estrogen on the secretion of LH
- analyze blood hormone data and physiological events of a single menstrual cycle to infer the roles of female sex hormones
- compare hormone regulatory mechanisms in male and female reproductive systems
- relate changing blood hormone levels to physiological events that occur in the ovary and uterus
- describe the hormone levels and the events that occur during the flow phase, follicular phase, ovulatory phase, and luteal phase of the menstrual cycle
- graph the changes in FSH, LH, estrogen, and progesterone levels in the blood through a single menstrual cycle
- evaluate the use of hormones such as FSH, LH, estrogen, and progesterone for altering reproductive cycles in a woman
- define menopause, and evaluate the use of estrogen and progesterone for treating symptoms of menopause
- evaluate the use of hormones such as FSH, LH, and testosterone for altering fertility in a man
- explain how the intake of endocrine-disrupting chemicals can influence secretion of a male or female hormone and therefore affect fertility and reproduction

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General Outcome B3: Students will explain how cell differentiation and development in the human organism are regulated by a combination of genetic, endocrine, and environmental factors

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• identify locations of fertilization and implantation • describe the sequence of events that leads to fertilization and implantation • describe the formation of the zygote, blastocyst, embryo, and fetus • describe the functions of the Fallopian tube, uterus, and vagina in the processes of fertilization and implantation	• identify the time of fertilization, cleavage, and implantation relative to the time of ovulation
• explain how the endometrium supports implantation and the development of an embryo • identify the tissues that form the placenta	• describe the development and function of the extra-embryonic membranes, including the amnion, chorion, and allantois • explain how the chorion and the endometrium form the placenta • explain how hormones secreted by the pituitary gland, ovary, and chorion regulate the development of the placenta
• identify the sources of hCG and LH, and describe how these hormones maintain pregnancy during the first trimester • describe the functions of the placenta and the umbilical cord	• interpret graphs of maternal levels of hCG, estrogen, and progesterone during pregnancy
• define differentiation • identify major tissues and organs that arise from the ectoderm, mesoderm, and endoderm in an embryo	• describe gastrulation and morphogenesis
• describe the main physiological events of embryonic and fetal development during each trimester	• observe changes during embryonic development using preserved materials, models, or computer simulations, and extrapolate these events to the development of a human
• identify environmental factors that affect embryonic and fetal development	• describe the effects of environmental factors, such as teratogens, on embryonic and fetal development
• describe how parturition is initiated by changes in levels of hormones such as progesterone, prostaglandins, and oxytocin	• sketch a positive feedback loop of the secretion of oxytocin in the control of parturition
• describe the function of prolactin in lactation	• sketch a positive feedback loop of the secretion of oxytocin in the control of lactation

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- identify different reproductive technologies related to conception control, *in vitro* fertilization, and infertility reversal

- describe the physiological or mechanical basis of different reproductive technologies such as conception control, *in vitro* fertilization, and infertility reversal
- describe the procedures of ultrasound imaging, amniocentesis, and chorionic villus sampling (CVS), and explain their uses
- identify social, cultural, environmental, ethical, and economic concerns regarding the use of reproductive technologies
- evaluate advantages and disadvantages of the use of reproductive technologies

General Outcome C1: Students will describe the processes of mitosis and meiosis

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• distinguish among chromosome, chromatin, chromatid, sister chromatids, and centromere	
• define haploidy, diploidy, and polyploidy	
• explain the significance of chromosome number in somatic and sex cells	
• compare the number and type of chromosomes in haploid gametes with those in diploid cells	
• explain that a species has a characteristic chromosome number	
• describe the events of the cell cycle, including interphase, mitosis, and cytokinesis	• on an illustration of the cell cycle, identify the phases and describe the major events occurring during these phases
• explain where and why mitosis occurs in organisms	
• identify the major events in the stages of mitosis using diagrams or models	• identify the major events in the stages of mitosis using microscope slides or photomicrographs • calculate the relative duration of each stage of mitosis using microscope slides of onion root tips
• describe the events in mitosis that are involved in maintaining a consistent number of chromosomes	• predict the effects of interference with mitotic structures or disruption of mitotic processes (e.g., cancer)
• distinguish between homologous and non-homologous chromosomes	
• describe the necessity for the reduction of chromosome number before fertilization	
• identify the major events in the stages of meiosis using diagrams or models	• identify the major events in the stages of meiosis using microscope slides or photomicrographs
• describe the events in meiosis that are involved in maintaining a consistent chromosome number in a species	
• compare spermatogenesis and oogenesis with reference to the number and size of gametes produced	• compare the processes of spermatogenesis and oogenesis
• identify the changes in chromosome number (ploidy) that occur during the first and second meiotic divisions	

- describe the process of crossing over
- compare the processes of mitosis and meiosis, including purpose of the process, number of divisions, chromosome content (ploidy) of the cells produced, number of cells produced, and type of cells produced
- distinguish between sexual and asexual reproduction
- compare the formation of fraternal (dizygotic) and identical (monozygotic) twins
- define nondisjunction and explain how it results in trisomy or monosomy
- identify normal and abnormal human karyotypes
- label a diagram of a life cycle to indicate the processes of mitosis, meiosis, fertilization, and the chromosome number (ploidy) of the structures indicated
- explain that a stem cell is unspecialized and capable of differentiating into other types of cells

- evaluate the effect of crossing over on the genetic makeup of an organism
- compare the consequences of an abnormality occurring in mitosis with the consequences of an abnormality occurring in meiosis
- compare the results of nondisjunction occurring in the first meiotic division with the results of nondisjunction occurring in the second meiotic division
- evaluate the significance of nondisjunction on inheritance and development (e.g., Down syndrome, Turner syndrome, Klinefelter syndrome)
- prepare and interpret human karyotypes using models or computer simulations
- describe the diversity of reproductive strategies by comparing the life cycles of a range of organisms
- examine diagrams of life cycles of various organisms to infer their reproductive strategies
- describe the use of cloning in plant and animal reproduction
- define totipotency with reference to stem cells
- describe the use of stem cells in the regeneration of damaged or missing parts of an organism

General Outcome C2: Students will explain the basic rules and processes associated with the transmission of genetic characteristics

A student achieving the *acceptable standard* can:

- explain the principles of dominance and segregation
- describe evidence for dominance and segregation, as investigated by Mendel

- distinguish among chromosomes, genes, and alleles
- distinguish between phenotype and genotype
- explain how genotype influences phenotype
- translate between phenotypes and the genotype symbols that represent them
- explain the difference between homozygous and heterozygous genotypes
- explain the difference between purebred and hybrid organisms

- illustrate and interpret the results of monohybrid and dihybrid crosses using Punnett squares
- compare ratios and probabilities of genotypes and phenotypes for dominant and recessive alleles; autosomal and sex-linked alleles; multiple alleles; and incompletely dominant or co-dominant alleles
- determine the relationship between alleles (dominant/recessive, incompletely dominant or co-dominant, multiple, or sex-linked) by observing genotypic or phenotypic ratios
- describe how a test cross is used to determine the genotype of an organism
- predict the results of crosses between parents of known genotypes and provide genotypic and phenotypic ratios of offspring
- express probabilities as decimals and as percentages
- describe patterns of inheritance of sex-linked traits
- distinguish a sex chromosome from an autosome
- explain that sex is determined by the sex chromosomes present in an organism

A student achieving the *standard of excellence* can:

- explain the principle of independent assortment
- describe evidence for the independent assortment of genes on different chromosomes, as investigated by Mendel
- illustrate the three principles (laws) of Mendelian genetics using Punnett squares

- infer the genotypes or phenotypes of parents by observing genotypic or phenotypic ratios of offspring
- design or perform an experiment to demonstrate the inheritance of a trait controlled by a single pair of alleles
- explain that predicted phenotypic ratios differ from actual counts in genetic crosses because of chance

- determine the pattern of inheritance of a trait by interpreting data illustrating autosomal and sex-linked inheritance

- determine the effect of lethal alleles on genotypic or phenotypic ratios
- describe the genetic basis for procedures such as selective breeding and genetic screening

- interpret data to determine if an allele is sex-linked

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- illustrate and interpret data using pedigree charts

- describe gene linkage

- analyze crossover data (recombination frequencies) for a single pair of chromosomes to create a chromosome map showing gene arrangement and relative distance

- infer the pattern of inheritance of a trait and the genotypes of individuals from a pedigree chart
- draw and interpret pedigree charts from data on single-allele and multiple-allele inheritance patterns
- explain the influence of gene linkage and crossing over on phenotypic ratios in a population
- explain the relationship between variability and the number of genes controlling a trait

- design a plan for collecting data to demonstrate inheritance in humans

General Outcome C3: Students will explain classical genetics at the molecular level

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• summarize the historical events that led to the discovery of the structure of the DNA molecule, including the work of Franklin and of Watson and Crick	
• explain that genes are composed of DNA, which contains specific sequences of base pairs	• identify the parts of a cell in which genetic material is located, including the nucleus, mitochondrion, and chloroplast
• describe the relationship between genes, DNA, and polypeptides	
• describe how genetic information is contained in the sequences of bases in DNA molecules	
• describe the molecular structure of DNA, including the complementary nature of the coding and non-coding strands	• construct a model of DNA to show the general structure and arrangement of bases (e.g., sugar-phosphate backbone, nitrogen bases, hydrogen bonding, complementary strands)
• sketch a nucleotide consisting of deoxyribose, phosphate, and a nitrogenous base (adenine, thymine, guanine, cytosine)	
• describe the semi-conservative nature of replication	
• explain how DNA molecules replicate themselves	• describe the function of DNA polymerase • describe how DNA repairs itself
• compare the structure and function of DNA and RNA	• perform simulations to demonstrate replication, transcription, and translation
• describe the molecular structure of RNA	
• sketch a nucleotide consisting of ribose, phosphate, and a nitrogenous base (adenine, uracil, guanine, cytosine)	
• describe how genetic information is transcribed from the coding strand of a DNA molecule into a sequence of bases in a messenger RNA molecule	• outline the events that occur during transcription, and explain the functions of codons, anticodons, initiator codons, and terminator codons
• distinguish between messenger RNA and transfer RNA	• outline the events that occur during translation

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• describe translation of messenger RNA into sequences of amino acids in proteins	• describe the function of RNA polymerase
• identify the products of gene expression (i.e., polypeptides, proteins)	• explain the significance of amino acid sequences within protein molecules in determining their structure and function
• describe the function of restriction and ligase enzymes	• explain how cells can be transformed by inserting new DNA sequences into their genomes (genetic engineering) • perform simulations to demonstrate the use of restriction and ligase enzymes • describe the process used to create recombinant DNA
• describe the effect of mutations on cells and organisms	• differentiate between a gene mutation and a chromosome mutation • differentiate between insertion, deletion, and substitution mutations
• explain how a mutation can result in an abnormality or provide a source of genetic variability	• analyze and infer the relationship between human activities and changes in genetic information that lead to inheritable mutations and cancer
• explain how similarities in genomes indicate that different species have common ancestry • describe the inheritance of mitochondrial DNA (mtDNA)	• explain the use of mtDNA and chloroplast DNA in establishing relationships between organisms
	• describe the benefits and detriments of genetic engineering for individuals, society, and the environment
• identify various biotechnologies that are based on molecular genetics	• describe the use of technologies such as gel electrophoresis, DNA "fingerprinting," polymerase chain reaction (PCR), gene therapy, transgenic organisms, and genetically modified organisms

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General Outcome D1: Students will describe a community as a composite of populations in which individuals contribute to a gene pool that can change over time

A student achieving the *acceptable standard* can:

- recognize that genetic variability exists within a population
- describe the Hardy–Weinberg principle

- list and describe the five conditions of the Hardy–Weinberg principle
- recognize when a population is in genetic equilibrium
- describe equilibrium values, where the values of p and q do not change over time, and non-equilibrium values, where the values of p and q change over time
- relate each term in the Hardy–Weinberg equation with frequencies of alleles, genotypes, and phenotypes
- outline the mathematical equation that expresses the Hardy–Weinberg principle
- demonstrate the ability to solve problems using the Hardy–Weinberg equation
- define gene pool

- describe the factors that cause the gene pool to change, including natural selection, genetic drift, gene flow, non-random mating, bottleneck effect, founder effect, migration, and mutation
- recognize that evolution results from a change in allele frequencies in the gene pool

- describe the molecular basis of changes in the gene pool and the significance of these changes over time, including mutations and natural selection

A student achieving the *standard of excellence* can:

- illustrate that the Hardy–Weinberg principle is based on probability
- explain how a disruption in any of the conditions of the Hardy-Weinberg principle affects gene frequencies
- explain the significance of stability in a population's gene pool
- apply the Hardy–Weinberg principle by performing experiments and simulations to demonstrate understanding of the concept

- design an experiment or simulation to illustrate population growth and change in the gene pool using the Hardy–Weinberg principle

- analyze data to determine if a population is evolving

- illustrate that a change in the gene pool over time can be directed by natural selection resulting in the evolution of a population
- compare the gene pool of a population that is evolving with the gene pool of a population that is not evolving

- explain that science and technology have both intended and unintended consequences for populations (e.g., antibiotic and pesticide resistance, introduction of exotic species, gene banks)
- explain what could happen to a population if there is a significant change in the gene pool over time (evolution, speciation)

General Outcome D2: Students will explain the interaction of individuals in a population with one another and with members of other populations

A student achieving the *acceptable standard* can:	A student achieving the *standard of excellence* can:
• define and recognize symbiotic relationships, including commensalism, mutualism, and parasitism • describe a symbiotic relationship in terms of the contribution of each species to the relationship	• describe the influence of symbiotic relationships on population changes
• describe predator–prey and producer–consumer relationships, and describe their influence on population changes	• perform simulations to investigate the relationships between predators and their prey • analyze data to interpret the relationship between predators and their prey
• construct a population graph illustrating a predator–prey relationship	• interpret a population graph illustrating a predator–prey relationship
• define and recognize interspecific competition and intraspecific competition and give examples of each • describe the influence of interspecific and intraspecific competition on changes in population size	• design an experiment or a simulation to demonstrate interspecific and intraspecific competition • analyze data to interpret the results of an experiment or simulation illustrating intraspecific or interspecific competition
• explain the role of defence mechanisms in predation and competition and give examples	
• define succession, pioneer community, and climax community • describe how a community is characterized by its populations • compare primary succession with secondary succession	• design an experiment to demonstrate succession • explain how a climax community can remain in a certain area • give an example of an ecological disturbance and how it can lead to succession in an area
• describe how a community in an area can change over time to become a climax community	• describe strategies and technologies that help sustain a community

General Outcome D3: Students will explain, in quantitative terms, the change in populations over time

A student achieving the *acceptable standard* can:

- identify and describe factors that influence population growth
- explain how mortality, natality, immigration, and emigration influence population growth
- determine change in population size using the formula ΔN = [natality + immigration] – [mortality + emigration]
- determine the growth rate of a population using the formula $gr = \Delta N/\Delta t$
- determine per capita growth rate of populations using the formula $cgr = \Delta N/N$
- determine the density of a population using the formula $D_p = N/A$ or $D_p = N/V$
- define carrying capacity, biotic potential, and environmental resistance, and describe their effect on the growth of a population
- define logistic growth and exponential growth
- illustrate theoretical growth curves for logistic (S-shaped) growth pattern and exponential (J-shaped) growth pattern of a population
- describe characteristics of open and closed populations
- explain the difference in growth patterns of open and closed populations
- illustrate how changes in factors that influence population growth would affect the population's growth curve
- describe characteristics and reproductive strategies of *r*-selected and *K*-selected species
- graph population growth of *r*-selected and *K*-selected species

A student achieving the *standard of excellence* can:

- explain factors influencing natality and mortality, such as age of sexual maturity, sex ratio, mate availability, gestation period, litter or clutch size, food supply, water supply, and availability of shelter
- compare the effect of density-dependent (biotic) and density-independent (abiotic) factors on natality and mortality
- design and perform an experiment or simulation to demonstrate the effect of environmental factors on population growth rate
- interpret data on population size, growth rate, per capita growth rate, and population density
- explain how density-dependent (biotic) and density-independent (abiotic) factors lead to logistic growth or exponential growth of a population
- label and describe the phases of a growth curve of a population (e.g., lag, growth, stationary, death)
- interpret population growth curves
- interpret a graph of population growth as that of an *r*-selected and *K*-selected species
- compare and evaluate the growth rates of human populations in various countries and predict implications of the growth rates (e.g., using histograms)

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January 2007 Biology 30 Diploma Examination Closed-Response Question (Written Response 1), Sample Responses and Scoring Guide

The following question is taken from the January 2007 Biology 30 Diploma Examination. The sample answers provided were used as a general guide for markers.

Use the following information to answer the first question.

Polychlorinated biphenyls (PCBs) are manufactured chemicals that were used for many years in materials such as inks and paints, as well as coolants for some electrical equipment. Since 1977, the manufacture and import of PCBs have been banned in Canada, but trace amounts of these persistent chemicals are still found in both our food and our bodies.

PCBs are endocrine disruptors that mimic the effects of estrogen. Exposure to endocrine disruptors can cause reduced fertility in men by decreasing the number of Sertoli cells in the testes.

Written Response—15% | Staple your word-processed response for **this** question to this page.

1. **a.** **Hypothesize** how exposure to PCBs can cause reduced fertility in men. (**2 marks**)

Sertoli cells support and nourish developing spermatids. A reduced number of Sertoli cells results in a reduced number of sperm and therefore decreased fertility.
or
Because PCBs mimic the effect of estrogen, they will suppress FSH secretion in a man, which will result in decreased spermatogenesis and reduced fertility.

b. **Describe** one technology that could be used to assist a man with reduced fertility to father a child. (**2 marks**)

In vitro *fertilization (IVF)*
Eggs are extracted from a woman and sperm are collected from a man. The eggs and sperm are mixed in a Petri dish in a laboratory, and a resulting embryo is inserted into the woman's uterus.

Testicular sperm extraction (TSE)
Sperm are extracted from the seminiferous tubules or epididymis of a man with a low sperm count. The sperm can be used for in vitro *fertilization.*

Intracytoplasmic sperm injection (ICSI)
A sperm is injected directly into a woman's egg.

Hormone treatment
Injections of FSH, LH, or testosterone could increase a man's sperm production. The man might be able to produce enough sperm for natural fertilization.
or
Any other appropriate technology

Use the following additional information to answer the next two parts of the question.

> Exposure to PCBs has been shown to affect prenatal brain development.

c. i. **Explain** how PCBs are able to pass from a woman to her embryo or fetus. (**1 mark**)

PCBs cross the placenta from the mother's blood to the fetal blood by diffusion.

ii. **Identify** the stage of pregnancy during which exposure to PCBs would have the greatest effect on prenatal brain development. (**1 mark**)

Exposure to PCBs in the first trimester of development would have the greatest effect on prenatal brain development.

Use the following additional information to answer the next part of the question.

> Exposure to PCBs has also been linked to the development of some forms of cancer. Cancer cells often have an abnormal number of chromosomes, which can be shown in a karyotype.

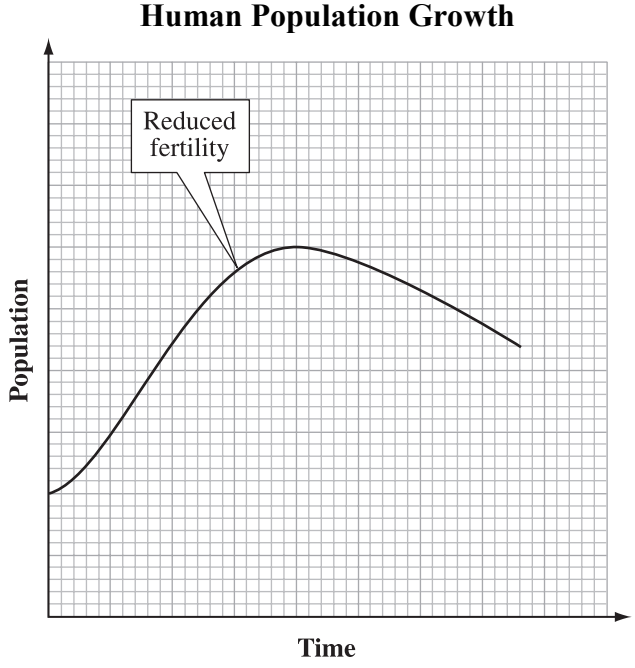
d. **Explain** which stage of mitosis is the best for showing an abnormal number of chromosomes in a cell. (**2 marks**)

Metaphase is the best stage for showing an abnormal number of chromosomes in a cell because the cell's chromosomes have shortened and are easily visible. The chromosomes are arranged at the equator of the cell and are easier to count than in other stages of mitosis.
or
Another phase of mitosis with a good explanation

Use the following additional information to answer the next two parts of the question.

> Some scientists believe that exposure to endocrine-disrupting chemicals is decreasing the fertility of the human population. When fertility decreases, the growth of the population is affected.

e. **Sketch** and **label** a hypothetical graph of the human population showing the effect that decreased fertility would have on population growth. Indicate on your graph where the effect of decreased fertility begins. (**3 marks**)



1 mark – labelled axes
1 mark – decrease in population number or decrease in the growth rate
1 mark – beginning of reduced fertility indicated on graph

f. **Explain** how decreased fertility would affect the biotic potential of the human population. (**1 mark**)

The biotic potential of the human population would decrease because the reproductive rate (fecundity) would decrease.

January 2007 Biology 30 Diploma Examination Open-Response Question (Written Response 2), Sample Responses and Scoring Guide

The following question is taken from the January 2007 Biology 30 Diploma Examination. The sample answers provided were used as a general guide for markers.

Use the following information to answer the next question.

Charcot-Marie-Tooth disease (CMT) is one of the most common inherited neurological disorders. CMT consists of a group of disorders caused by mutations in genes that affect the normal functions of neurons in the peripheral nervous system. Mutations in one gene can cause demyelination, which is the breakdown of the myelin sheath. Mutations in another gene can cause axonopathy, which is an impairment of axon function. CMT is usually inherited in an autosomal dominant pattern; however, CMT can also be inherited in an autosomal recessive pattern or an X-linked recessive pattern. The different types of CMT are distinguished by inheritance pattern, age of onset, severity of symptoms, and whether the axon or myelin sheath is affected.

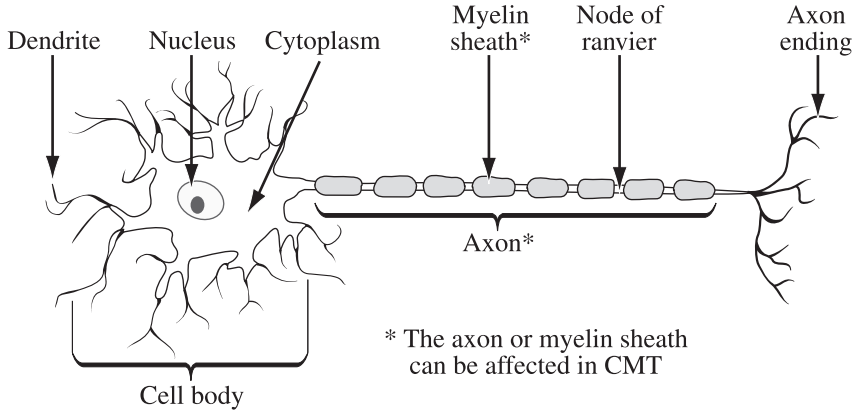
Individuals affected with CMT slowly lose motor and sensory function in their feet, legs, hands, and arms as nerves in the extremities degenerate. The muscles in the extremities weaken because of the loss of stimulation by the affected nerves. The progressive muscular weakening makes fine motor actions of the hands difficult. There is also a loss of sensory nerve function. Most people with CMT have a decreased sensitivity to heat, to touch, and to pain in the feet and legs.

Diagnosis of CMT involves testing of motor and sensory responses, as well as evaluation of muscle atrophy. Some forms of CMT can now be diagnosed by genetic testing. Although there is no cure for CMT, there are treatments that can manage the symptoms effectively.

Written Response—15% | Staple your word-processed response for **this** question to this page.

2. Write a unified response that addresses the points identified below.

- **Sketch** a diagram of a myelinated neuron, and **label** four parts. On your diagram, clearly indicate the two regions of the neuron that can be affected in CMT.



- **Describe** two ways that CMT could affect nerve impulse conduction, and **explain** how each of these effects relates to nerve damage.

  Nerve impulses would be slower because of the demyelination of the axons. The myelin sheath electrically insulates the axon and prevents the movement of ions across the axon membrane where the myelin is present. Nerve impulses normally move down the axon in a saltatory manner (jump from node to node); therefore, the absence of myelin slows nerve impulse transmission.

  Nerve impulses would also be reduced because of the axonopathy. While the speed of nerve impulse conduction could be normal, defects within the axons themselves would inhibit conduction. As a result, fewer nerve impulses would be transmitted.

- **Describe** two kinds of evidence that could be obtained from a pedigree to determine whether the mode of inheritance of CMT is dominant or recessive. **Describe** two kinds of evidence that could be obtained from a pedigree to determine whether the mode of inheritance of a recessive form of CMT is autosomal or X-linked.

  If CMT is inherited as a dominant trait, then
  - *unaffected offspring can be produced by affected parents*
  - *affected offspring must have an affected parent*
  - *the trait does not skip a generation and then reappear in later generations*

  If CMT is inherited as a recessive trait, then
  - *affected parents produce only affected offspring*
  - *unaffected parents can produce affected offspring*
  - *the trait can skip a generation and then reappear in later generations*

  If a recessive form of CMT is inherited as an autosomal trait, then
  - *males and females are affected equally*
  - *affected mothers can produce unaffected sons*

  If a recessive form of CMT is inherited as an X-linked trait, then
  - *it is more common in males than in females*
  - *all the sons of an affected mother are affected with the disorder*
  - *an affected daughter must have an affected father*

- **Identify** two technologies that could assist individuals with CMT. **Explain** how these technologies would help them to manage the symptoms of this disease.

  Physical therapy, which usually consists of low-impact exercises and stretching, can prevent muscle tightening and joint stiffening that result in deformities of the hands and feet. Physical therapy also maintains muscle strength and endurance.

  Occupational therapy helps people with everyday living. For example, an occupational therapist might recommend that those with the loss of fine motor skills use rubber grips on the doors at home, Velcro and snaps instead of laces and buttons, etc.

  Special shoes or shoe inserts could be worn. Wearing boots or high-top shoes can help support the ankles and increase balance. Custom shoes or shoe inserts can help improve gait (manner of walking).

  Orthopedic leg braces, splints, and removable casts can help support the ankles and compensate for muscular weakness.

  Corrective foot or hand surgery could be performed to loosen tight muscles and tendons, or to correct bone deformities.

  Wheelchairs, walkers, motorized scooters, and other mobility aids can help those with severe CMT to move around.

  Medications can be used to help reduce pain associated with CMT or reduce further demyelination of the peripheral nerves.

  Gene therapy could be used to deliver genes that produce myelin in order to increase myelination in affected nerves and reduce the symptoms of CMT.

- **Describe** two advantages and two disadvantages to the individual and/or society of having a genetic test to determine whether a person will have CMT.

Advantages
An individual can make plans for the future based on the knowledge of the expected development of symptoms of CMT.

In consultation with their doctor or genetic counsellor, a couple could decide to adopt a child instead of risking the birth of a child with CMT. This could prevent emotional and financial hardship for the couple.

If a fetus is found to have CMT, a woman/couple could have the choice to terminate the pregnancy. This would reduce the emotional and financial hardship for the couple. The cost to society/the health-care system for the treatment of a CMT child would also be reduced.

If fewer babies with CMT were born because of prenatal diagnosis of the disorder, the health-care system would spend less money on treatment of the symptoms of CMT. This would make more money available for treatment of other diseases.

The more people that are diagnosed with CMT, the more the public will become aware of this disorder. For example, the Muscular Dystrophy Association and other groups publicly campaign for funding to help families affected by CMT. Increased public awareness of CMT could help fundraising for the research and treatment of CMT.
or
Any other reasonable answer

Disadvantages
If an individual learns that his/her health will deteriorate due to the onset of CMT, this knowledge could lead to psychological depression.

If an employer learns that a potential employee has a genetic mutation for CMT, the person may not be hired because of the expected cost to the employer of health-care and insurance premiums.

A person who has no symptoms of CMT could be denied health insurance or life insurance because of a positive genetic test for the disorder.

Certain groups consider the abortion of any fetus to be unethical.
or
Any other reasonable answer

Science

Score	Scoring Criteria The student…
5 **Excellent**	• sketches a neuron with three or four labelled structures and indicates the myelin sheath and axon as affected in CMT • describes two ways that CMT affects impulse conduction and explains how they are related to demyelination and axonopathy • describes two kinds of evidence from a pedigree used to determine whether inheritance is dominant or recessive and two kinds of evidence to determine whether inheritance is X-linked or autosomal
4 **Good**	• sketches a neuron with three labelled structures and indicates the myelin sheath or axon as affected in CMT **or** sketches a neuron with two labelled structures and indicates the myelin sheath and axon as affected • describes two ways that CMT affects impulse conduction and explains how one is related to demyelination or axonopathy • describes two kinds of evidence used to determine whether inheritance is dominant or recessive and one kind of evidence to determine whether inheritance is X-linked or autosomal **or** describes one kind of evidence used to determine whether inheritance is dominant or recessive and two kinds of evidence to determine whether inheritance is X-linked or autosomal
3 **Satisfactory**	• sketches a neuron with two labelled structures and indicates the myelin sheath or axon as affected in CMT **or** sketches a neuron with one labelled structure and indicates the myelin sheath and axon as affected **or** sketches a neuron with three or four labelled structures • describes one way CMT affects impulse conduction and explains how this is related to demyelination or axonopathy • describes one kind of evidence used to determine whether inheritance of CMT is dominant or recessive and one kind of evidence to determine whether inheritance is X-linked or autosomal **or** describes two kinds of evidence used to determine whether inheritance is dominant or recessive **or** describes two kinds of evidence to determine whether inheritance is X-linked or autosomal
2 **Limited**	• sketches a neuron with two labelled structures **or** sketches a neuron with one labelled structure and indicates the myelin sheath or axon as affected in CMT • describes one way that CMT affects impulse conduction **or** explains how impulse conduction is related to demyelination or axonopathy • describes one piece of evidence from a pedigree that can be used to determine the mode of inheritance of CMT
1 **Poor**	• addresses only one of the three bullets at a 2 or a 3 level
0 **Insufficient**	• does not address the question presented or provides an answer that is too brief to assess
NR	• does not provide a response

Technology and Society

Score	Scoring Criteria The student…
5 **Excellent**	• clearly identifies two technologies used and clearly explains how they could help manage the symptoms of CMT • clearly describes two advantages and two disadvantages of a genetic test for CMT to the individual and/or society
4 **Good**	• identifies two technologies used and explains how one could help manage the symptoms of CMT **or** identifies one technology and explains how two technologies could help manage the symptoms • describes two advantages and one disadvantage of a genetic test for CMT **or** describes one advantage and two disadvantages
3 **Satisfactory**	• identifies two technologies used **or** explains how two technologies could help manage the symptoms of CMT **or** identifies and explains one technology • describes one advantage and one disadvantage of a genetic test for CMT **or** describes two advantages **or** describes two disadvantages
2 **Limited**	• identifies one technology used **or** explains how one technology could help manage the symptoms • describes one advantage or one disadvantage of a genetic test for CMT
1 **Poor**	• addresses only one of the two bullets at a 2 level
0 **Insufficient**	• does not address the question presented or provides an answer that is too brief to assess
NR	• does not provide a response

June 2007 Biology 30 Diploma Examination Closed-Response Question (Written Response 1), Sample Responses and Scoring Guide

The following question is taken from the June 2007 Biology 30 Diploma Examination. The sample answers provided were used as a general guide for markers.

Use the following information to answer the first question.

HSAN-II is an autosomal recessive disorder characterized by the progressive loss of myelinated sensory neurons and by the loss of sensory receptors in the skin. Individuals with this disorder display reduced sensitivity to pain, temperature, and pressure, especially in the hands and feet. Reduced sensitivity can lead to injuries of the hands and feet.

—based on Lafrenière, Ronald G., et al., 2004. Identification of a novel gene (*HSN2*) causing hereditary sensory and autonomic neuropathy type II through the study of Canadian genetic isolates. *The American Journal of Human Genetics* 74: 1064–1073.

Written Response—15% | Staple your word-processed response for **this** question to this page.

1. **a.** **i.** **Describe** the effect of HSAN-II on sensory nerve impulse transmission. **(1 mark)**

There will be fewer sensory impulses in a person with HSAN-II if sensory receptors in the skin have been lost.

The speed of nerve impulse transmission will be slower in a person with HSAN-II who has damaged sensory neurons.

ii. **Explain** how the absence of sensory receptors in the skin can lead to injuries of the hands and feet. **(2 marks)**

The absence of sensory receptors in the skin prevents a person from detecting stimuli and sensing pain. A person who has HSAN-II will not have a normal withdrawal reflex and therefore will not be able to avoid injury.

b. A man and a woman who do not have HSAN-II have two children. One child has HSAN-II and the other child does not have the disorder. **Identify** the genotypes of the man and the woman. **(1 mark)**

The man and the woman are both heterozygous for HSAN-II.
or
The man and the woman both have the genotype Hh, *where* H = *the normal allele and* h = *the allele that causes HSAN-II.*

Use the following additional information to answer the next part of the question.

A mutation in a gene known as *HSN2* causes the HSAN-II disorder. A section of the normal coding sequence of the *HSN2* gene is shown below.

CCT CAA TCA GTT

In one mutation, an adenine base is inserted between the sixth (A) and seventh (T) bases of the section of the normal *HSN2* sequence shown above.

—based on Lafrenière et al., 2004

c. **Explain** how the amino acid chain produced from the normal *HSN2* gene differs from the amino acid chain produced from the mutated *HSN2* gene. **(2 marks)**

The mRNA codon for the amino acid serine is replaced by a stop codon when the mutated gene is transcribed. Instead of translating the remainder of the mRNA strand, protein synthesis stops at the abnormal codon.

Use the following additional information to answer the next two parts of the question.

A population in a geographically isolated region in northeastern Newfoundland has a high incidence of HSAN-II. Researchers collected DNA samples from 57 individuals in this region and identified eight people as having HSAN-II.

—based on Lafrenière et al., 2004

d. **Determine** the frequency of the heterozygous genotype in the study population. Round your answer to three decimal places. Show your work. **(3 marks)**

$q^2 = 8/57 = 0.140350877$
$q = \sqrt{0.140350877} = 0.375$
$p = 1 - 0.375 = 0.625$
$2pq = 2(0.625)(0.375) = 0.469$

or

$q^2 = 8/57 = 0.140$
$q = \sqrt{0.140} = 0.374$
$p = 1 - 0.374 = 0.626$
$2pq = 2(0.626)(0.374) = 0.468$

The frequency of the heterozygous genotype is 0.469 (0.468).

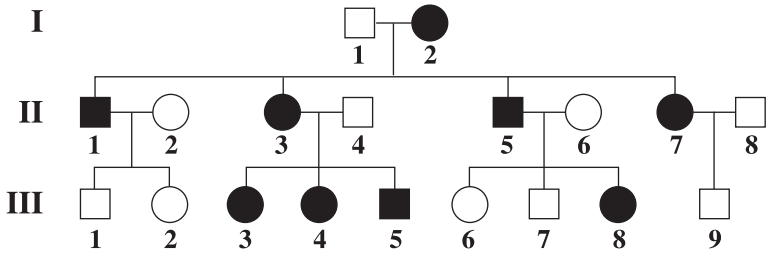
e. **Identify** and **describe** a technology that can be used to help predict the risk of a couple's having a child affected with HSAN-II. **(2 marks)**

- *Pedigree analysis – a genetic trait is traced through several generations of a family using a chart and standard symbols*
- *Punnett square – a chart that is used to determine the probability of the parents' alleles combining to produce certain genotypes in their children*
- *Gene sequencing machines – computers and other tools are used to determine the nucleotide base sequence in a DNA fragment*
- *Gene mapping – a sample of DNA is sequenced to locate specific alleles of a gene*
- *DNA fingerprinting – an image similar to a bar code is produced from DNA fragments*

Use the following additional information to answer the next part of the question.

HSAN-I is a genetic disorder that is closely related to HSAN-II; however, its pattern of inheritance is different from that of HSAN-II.

Pedigree Illustrating the Inheritance of HSAN-I



f. **Identify** the pattern of inheritance of HSAN-I. **(1 mark)**

The pattern of inheritance is autosomal dominant.

June 2007 Biology 30 Diploma Examination Open-Response Question (Written Response 2), Sample Responses and Scoring Guide

The following question is taken from the June 2007 Biology 30 Diploma Examination. The sample answers provided were used as a general guide for markers.

Use the following information to answer the next question.

A group of Canadian researchers studied the effect of exercise on the risk of women developing ovarian cancer, which is the rapid, uncontrolled growth of ovarian cells. The researchers concluded that women who regularly engage in moderate physical activity, such as walking, gardening, and golfing, have a significantly decreased risk of developing ovarian cancer. High levels of estrogen and progesterone are associated with ovarian cancer. Moderate physical activity decreases circulating levels of these two hormones and may decrease a woman's risk of developing ovarian cancer as a result. Physical activity may also decrease a woman's risk of developing ovarian cancer by reducing the number of ovulatory cycles that she has in her lifetime.

Another risk factor for ovarian cancer is obesity. Obesity is also linked to a reduced sensitivity of cells to insulin, whereas exercise increases the sensitivity of cells to insulin.

—based on Pan, Sai Yi, Anne-Marie Ugnat, Yang Mao, and The Canadian Cancer Registries Epidemiology Research Group. 2005. Physical activity and the risk of ovarian cancer: A case-control study in Canada. *International Journal of Cancer* 117: 300–307.

Written Response—15% | Staple your word-processed response for **this** question to this page.

2. Write a unified response addressing the points identified below.

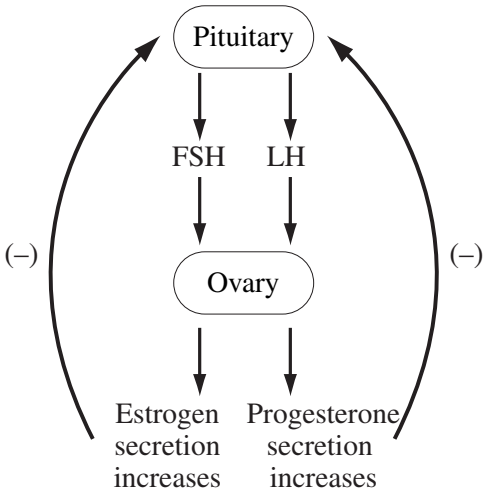
- **Describe** how the cell cycle is altered in cancerous ovarian cells. **Hypothesize** how a woman's risk of developing ovarian cancer may be decreased if the number of ovulatory cycles that she has in her lifetime is reduced.

  The cell cycle is shortened in cancerous ovarian cells. Interphase is shorter than in non-cancerous cells. The cells reproduce at a faster rate, quickly producing large numbers of abnormal cells.

  A woman's risk of ovarian cancer may be decreased because the woman will be exposed to lower cumulative levels of estrogen and progesterone hormones during her lifetime. Estrogen and progesterone are secreted during each ovulatory cycle; therefore, if a woman had fewer ovulatory cycles, the result would be reduced secretion of these hormones.

- **Describe** the functions of estrogen and progesterone. **Sketch** a feedback loop to illustrate the effects of an increased secretion of estrogen and progesterone on the secretion of pituitary hormones.

  Estrogen stimulates the development and maintenance of secondary sex characteristics in a woman, and it stimulates the proliferation and thickening of the endometrium. Progesterone stimulates the continued development and maintenance of the endometrium.



- **Describe** an effect of reduced sensitivity of cells to insulin. **Identify** the hormone that maintains blood glucose levels during physical activity. **Explain** how this hormone maintains homeostasis during physical activity.

  A reduced sensitivity of cells to insulin results in cells having a lower-than-normal permeability to glucose. Glucose remains in the blood and therefore less is available for energy production in cells. A person with reduced sensitivity to insulin feels tired and has a low energy level.

  The hormone that maintains blood glucose levels during physical activity is glucagon. Blood glucose levels are lower than normal during physical activity because cell respiration increases glucose use. Glucagon is released from the pancreas, which stimulates the conversion of glycogen to glucose in the liver. Glucose is released into the blood and the glucose level rises. Homeostasis is restored.
  or
  The hormone that maintains blood glucose levels during physical activity is epinephrine. Epinephrine is released from the adrenal glands during physical activity, and this release stimulates the conversion of glycogen to glucose in the liver. Glucose is released into the blood and the glucose level rises. Homeostasis is restored.

- **Identify** two technologies that can be used to diagnose ovarian cancer. **Describe** how each of these technologies may assist a health-care professional in the diagnosis of ovarian cancer.

  - *Magnetic resonance imaging (MRI) – a computer-assisted imaging technique in which a powerful electromagnet is used to create an image of the ovaries*
  - *Ultrasound imaging – high-frequency sound waves are used to create an image of the ovaries*
  - *Biopsy of ovarian tissue – a sample of ovarian tissue is removed and examined under a microscope*
  - *Needle aspiration cytology – a needle is used to suction fluid that surrounds the ovaries for examination under a microscope*
  - *Microscope – ovarian cells can be visually examined for abnormalities*
  - *Laparoscopy – abdominal surgery performed to obtain an ovarian tissue sample using a small incision through which a tube containing a light and a camera is inserted*
  - *Surgery – surgery is performed through an abdominal incision to obtain an ovarian tissue sample*
  - *CT scan – an imaging technique in which an X-ray machine rotates around the body and takes pictures at numerous angles. A computer puts the scans together and creates detailed images of the ovaries in cross-section*
  - *Use of a contrast medium – a dye is injected into the blood to highlight the ovaries during CT scanning*
  - *Pelvic examination / palpation of abdomen – palpation (feeling) for unusual growths and/or enlarged ovaries*
  - *Blood analysis for levels of estrogen and progesterone – an increase in levels of these hormones can indicate the presence of ovarian cancer*
  - *Blood analysis for a tumour marker – an increase in certain specific blood proteins can indicate the presence of ovarian cancer*
  - *Genetic mutation screening – identifies the presence of certain genetic mutations specifically associated with some types of ovarian cancer*
  - *Pap smear – may be used to confirm an existing diagnosis, since cancerous ovarian cells are occasionally discovered when the slide of cervical cells is examined*

- **Describe** two benefits to an individual and two benefits to society of an increase in regular, moderate physical activity in a person's lifestyle.

Benefits to the individual

- *Increased cardiovascular fitness*
- *Increased strength / muscle development*
- *Increased sense of well-being*
- *Increased lifespan*
- *Improved sleep*
- *Improved immune function*
- *Maintenance of a healthy weight*
- *Reduced blood pressure*
- *Reduced blood cholesterol level*
- *Reduced risk of diabetes*
- *Reduced risk of cancer*
- *Reduced risk of osteoporosis*
- *Reduced feelings of depression and anxiety*

or

Any other reasonable answer

Benefits to society

- *Reduced health-care cost to society since people will improve their health and will need to access health care less frequently*
- *Reduced crime rates resulting from an increased sense of well-being in more members of society*
- *Reduced emissions from cars if people walk or use a bicycle as a mode of transportation to increase physical activity in their lifestyles*
- *Reduced cost of social programs since people will live longer and be able to care for family members longer*
- *Reduced need for long-term care facilities since physical activity will help the elderly and the disabled increase their independence/ability to carry out daily activities*

or

Any other reasonable answer

Science

Score	Scoring Criteria The student…
5 **Excellent**	• completely describes how the cell cycle is altered in cancerous cells and gives a complete hypothesis of how a reduced number of ovulatory cycles may decrease the risk of ovarian cancer • describes the functions of estrogen and progesterone and sketches a complete feedback loop illustrating the effect of increased secretion of estrogen and progesterone on secretion of pituitary hormones • describes an effect of reduced sensitivity of cells to insulin, identifies the hormone that maintains blood glucose during physical activity, and completely explains how the hormone maintains homeostasis during physical activity
4 **Good**	• completely describes how the cell cycle is altered in cancerous cells and gives a partial hypothesis **or** partially describes how the cell cycle is altered and gives a complete hypothesis • describes the functions of estrogen and progesterone, and sketches a partial feedback loop **or** describes the function of either estrogen or progesterone, and sketches a complete feedback loop • describes an effect of reduced sensitivity of cells to insulin and identifies the hormone that maintains blood glucose **or** describes an effect of reduced sensitivity of cells to insulin and explains how the hormone maintains homeostasis **or** identifies the hormone that maintains blood glucose and explains how the hormone maintains homeostasis
3 **Satisfactory**	• describes how the cell cycle is altered in cancerous cells **or** gives a complete hypothesis **or** partially describes how the cell cycle is altered and gives a partial hypothesis • describes the functions of estrogen and progesterone **or** sketches a complete feedback loop **or** describes the function of either estrogen or progesterone and sketches a partial feedback loop • describes an effect of reduced sensitivity of cells to insulin **or** identifies the hormone that maintains blood glucose during physical activity **or** explains how the hormone maintains homeostasis
2 **Limited**	• describes the cell cycle **or** attempts a hypothesis • describes the function of estrogen or progesterone **or** attempts a sketch of a feedback loop • attempts a description or explanation of one aspect of blood glucose homeostasis
1 **Poor**	• addresses only one of the three bullets at a 2 or a 3 level
0 **Insufficient**	• does not address the question presented or provides an answer that is too brief to assess
NR	• does not provide a response

Technology and Society

Score	Scoring Criteria The student…
5 Excellent	• identifies two technologies that can be used to diagnose ovarian cancer and describes how the two technologies assist a health-care professional in the diagnosis of ovarian cancer • describes two benefits to an individual and two benefits to society of an increase in regular physical activity in a person's lifestyle
4 Good	• identifies two technologies that can be used to diagnose ovarian cancer and describes how one of the technologies assists in diagnosis **or** identifies one technology and describes how two technologies assist in diagnosis • describes two benefits to an individual and one benefit to society **or** describes one benefit to an individual and two benefits to society
3 Satisfactory	• identifies one technology that can be used to diagnose ovarian cancer and describes how one technology assists in diagnosis **or** identifies two technologies **or** describes how two technologies assist in diagnosis • describes two benefits to an individual **or** describes two benefits to society **or** describes one benefit to an individual and one benefit to society
2 Limited	• identifies or describes one technology that can be used in cancer diagnosis • describes one benefit to an individual or to society
1 Poor	• addresses only one of the two bullets at a 2 or a 3 level
0 Insufficient	• does not address the question presented or provides an answer that is too brief to assess
NR	• does not provide a response