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Introduction

The questions in this document are from the Biology 30 August 2012 Diploma Examination. This material, along with the program of studies, information bulletin, assessment highlights, and school authority or school reports, can provide insight for teachers to assist them with instructional programming.

The table on the following pages shows the keyed response, outcome classification according to the program of studies, classification of cognitive level, and the difficulty, indicated by the percentage of students who got the question correct, for each item. A complete explanation of the classification of cognitive level can be found in the *Biology 30 Information Bulletin*.

Additional Documents

The Assessment Sector supports the instruction of Biology 30 with the following documents available online.

- [Biology 30 Assessment Highlights](#)
available at education.alberta.ca
From the home page, follow this path:
Teachers > (Additional Programs and Services) Diploma Exams > Assessment Highlights. A general description of characteristics of student responses, including strengths and areas for improvement, as noted by the assessment standards team leader and the examiner for the January and June 2012 Biology 30 Diploma Examinations.
- [Biology 30 Information Bulletin and Biology 30 Information Bulletin – Archived Curriculum Standards and Example Questions](#)
available at education.alberta.ca
From the home page, follow this path:
Teachers > (Additional Programs and Services) Diploma Exams > Information Bulletins. Contain information about the diploma examinations for the upcoming school year, sample questions, and assessment samples for classroom use.
- [Biology 30 Practice Questions](#)
Previous diploma examination questions and some practice questions have been released for Biology 30. From the home page, follow this path:
<https://questaplus.alberta.ca>

Biology 30 Diploma Examination August 2012— Blueprint Summary

Key: MC—Multiple Choice; NR—Numerical Response
K—Knowledge; C/A—Comprehension/Application; HMA—Higher Mental Activities

Question	Key	Outcome	Cognitive Level	Difficulty (%)
MC1	C	A1.1k	C/A	52.2
MC2	D	A1.1k	C/A	57.7
MC3	A	A1.2k, A1.3sts	K	51.8
MC4	C	A1.2k, A1.3sts	K	82.0
NR1	3124	A1.4k, A1.2s	K	69.6
NR2	1245 (any order)	A2.1k, A2.2s	C/A	67.5
MC5	A	A2.3k	K	83.1
MC6	C	B1.1k, B1.2s	K	78.4
MC7	D	B1.1k, B1.2s	C/A	82.2
MC8	A	B2.3k, B3.2sts	C/A	64.1
MC9	B	B1.2k, B1.2s, B1.1sts	C/A	58.2
MC10	D	B2.2k, B2.2s	C/A	41.4
MC11	B	B2.2k	K	59.1
MC12	A	B3.5k, B3.1sts	C/A	46.5
MC13	B	B3.5k, B3.1sts	C/A	58.7
NR3	321	B3.4k, B3.2sts	C/A	79.3
MC14	D	B3.3k	K	62.8
MC15	D	C1.1k, C1.1sts	C/A	64.2
MC16	A	C1.3k	C/A	80.7
MC17	A	C1.2k	HMA	64.9
MC18	A	C1.1k, C1.1sts	C/A	58.4
MC19	C	C1.1k, C1.3s	C/A	58.4
MC20	C	C1.3k	C/A	48.9
MC21	A	C2.5k	C/A	56.9
MC22	A	C2.2k, C2.3s	C/A	77.0
NR4	0.50	C2.2k, C2.3s	C/A	76.7
MC23	B	C3.2k	K	68.0

Biology 30 Diploma Examination August 2012— Blueprint Summary

Key: MC—Multiple Choice; NR—Numerical Response

K—Knowledge; C/A—Comprehension/Application; HMA—Higher Mental Activities

Question	Key	Outcome	Cognitive Level	Difficulty (%)
MC24	C	C3.3k	C/A	67.1
MC25	C	C3.7k, C3.2s	C/A	69.0
MC26	D	C3.5k, C3.2sts	C/A	87.8
MC27	A	C3.2k, C3.2sts	C/A	69.7
MC28	D	C3.6k	C/A	74.0
NR5	0.20	D1.3k, D1.3s	C/A	56.5
MC29	B	D3.4k	C/A	84.4
MC30	C	D2.3k	K	61.7
MC31	B	D2.1k	C/A	62.2

Use the following information to answer the first two questions.

Scientists have discovered that a molecule called allicin causes the characteristic burning taste produced by raw garlic. When allicin attaches to specialized receptors on a neuron, calcium channels in the membrane open. This results in the flow of calcium ions, Ca^{2+} , into the neuron, which causes a reversal of charge inside a resting neuron.

1. The flow of calcium ions into the neuron initiates
 - A. polarization
 - B. repolarization
 - C. an action potential
 - D. a refractory period

 2. The effect of allicin on a neuron is similar to the effect of
 - A. cholinesterase
 - B. potassium ions
 - C. an inhibitory neurotransmitter
 - D. an excitatory neurotransmitter
-

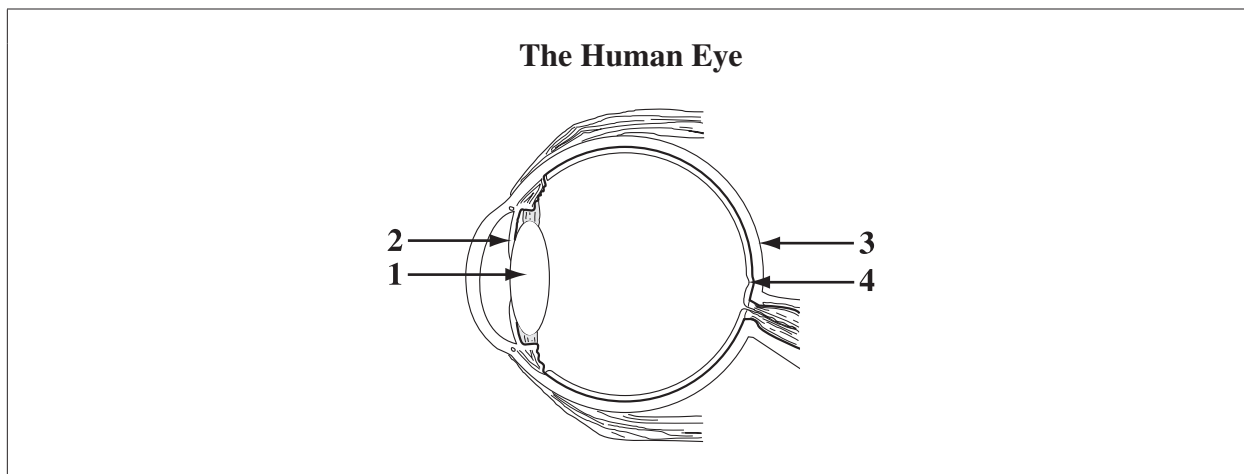
Use the following information to answer the next two questions.

Acupuncture has been used in Chinese medicine for thousands of years as a treatment for chronic pain and other ailments. Acupuncture increases the level of endorphins in the central nervous system. Endorphins affect the part of the brain that interprets pain stimuli. Acupuncture also affects the part of the brain that interacts with the endocrine system in the maintenance of homeostasis.

3. The part of the brain that is affected by acupuncture in the treatment of chronic pain is the
 - A. cerebrum
 - B. cerebellum
 - C. hypothalamus
 - D. medulla oblongata

4. The part of the brain that is affected by acupuncture in the treatment of ailments involving endocrine control is the
 - A. cerebrum
 - B. cerebellum
 - C. hypothalamus
 - D. medulla oblongata

Use the following information to answer the next question.



Numerical Response

1. Match each of the structures of the human eye numbered in the diagram above with the descriptions given below.

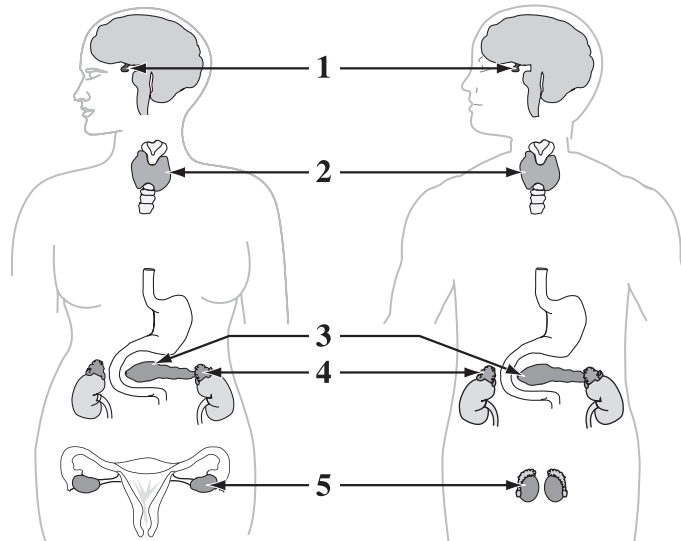
Structure:	_____	_____	_____	_____
Description:	Maintains shape of eye	Focuses light	Regulates entry of light	Contains light-sensitive pigments

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

Use the following information to answer the next question.

Stress-age syndrome is a disorder that limits a person's ability to physically and psychologically cope with stress. This disorder causes an increase in the secretion of epinephrine, ACTH, and cortisol, and a decrease in the secretion of testosterone, estrogen, and thyroxine.

Some Endocrine Structures



Numerical Response

2. In the diagram above, four endocrine structures that are directly affected in stress-age syndrome are numbered _____, _____, _____, and _____.

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

Use the following information to answer the next question.

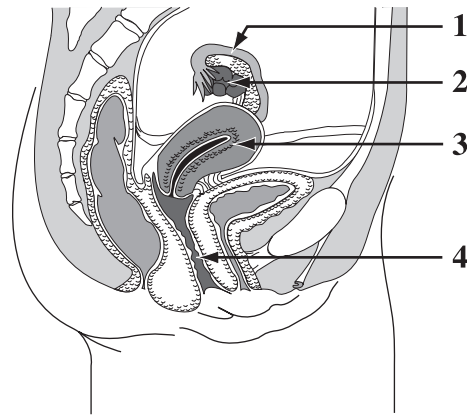
An athlete running a marathon can lose a large quantity of water as a result of sweating.

5. The hormone that is secreted in greater-than-normal amounts in order to conserve water in an athlete running a marathon is
- A. ADH
 - B. ACTH
 - C. cortisol
 - D. thyroxine

Use the following information to answer the next two questions.

Endometriosis occurs when endometrial tissue is found in a location other than the uterus. The tissue builds up and breaks down with each menstrual cycle, causing severe pain. The abnormal endometrial tissue can cause scarring and damage to reproductive organs.

Female Reproductive System



6. In the diagram above, the tissue associated with endometriosis originates in the structure numbered
- A. 1
 - B. 2
 - C. 3
 - D. 4
7. Scarring of structure 1 in the diagram above could cause infertility because of decreased
- A. frequency of ovulation
 - B. production of sex hormones
 - C. thickness of the endometrium
 - D. chance for sperm to reach an egg

Use the following information to answer the next question.

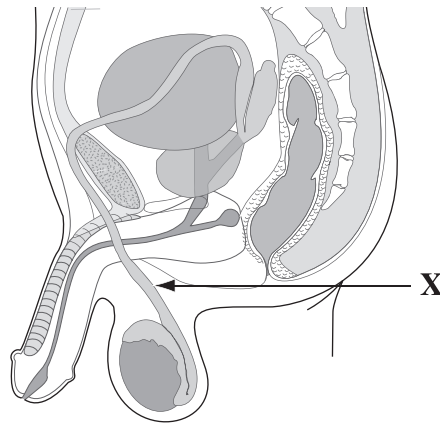
Polybrominated diphenyl ethers (PBDEs) are chemicals that are used to fireproof consumer products such as furniture and computer casings. PBDEs interfere with an enzyme that is necessary for the production of testosterone.

8. The hormone that is expected to be found in greater-than-normal amounts in a man who has been exposed to PBDEs is
- A. LH
 - B. FSH
 - C. hGH
 - D. ACTH

Use the following information to answer the next question.

Sexually transmitted infections can result in the formation of blockages in the male reproductive system.

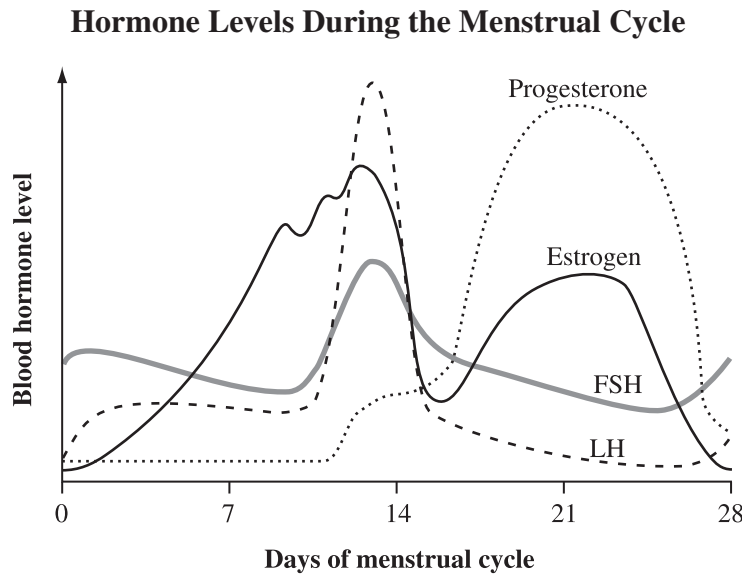
Male Reproductive System



9. A partial blockage of structure X would result in a
- A. low level of testosterone and a low sperm count
 - B. normal level of testosterone and a low sperm count
 - C. low level of testosterone and a low volume of seminal fluid
 - D. normal level of testosterone and a low volume of seminal fluid

Use the following information to answer the next two questions.

Symptoms of premenstrual syndrome (PMS) are usually the most severe during the seven days prior to menstrual flow.



10. Which of the following rows identifies the reproductive hormone levels that coincide with severe symptoms of PMS in the seven days prior to menstrual flow?

Row	Progesterone	LH	FSH
A.	Increasing	Increasing then decreasing	Increasing then decreasing
B.	Increasing	Decreasing then increasing	Decreasing then increasing
C.	Decreasing	Increasing then decreasing	Increasing then decreasing
D.	Decreasing	Decreasing then increasing	Decreasing then increasing

11. Hormones that **directly** control the secretion of a woman's sex hormones are released from the
- A. ovary
 - B. pituitary
 - C. endometrium
 - D. hypothalamus

Use the following information to answer the next two questions.

During the process of in vitro fertilization, an egg is fertilized in a Petri dish. The fertilized egg then undergoes cell division for several days, and the resulting structure is implanted into a woman's uterus.

12. Which of the following rows identifies the structure produced by in vitro fertilization that is implanted into a woman's uterus and the phase of the woman's menstrual cycle during which implantation would be most successful?

Row	Structure	Phase of the Menstrual Cycle
A.	Blastocyst	Luteal phase
B.	Blastocyst	Follicular phase
C.	Zygote	Luteal phase
D.	Zygote	Follicular phase

Use the following additional information to answer the next question.

The increased use of in vitro fertilization has resulted in an increase in the number of twins born.

13. Which of the following steps during in vitro fertilization is **directly** responsible for the increase in the number of twins born?
- A. Zygotes develop into clusters of two to eight cells.
 - B. Two or more embryos are implanted in a woman's uterus.
 - C. A woman is injected with hormones to stimulate follicular development.
 - D. Several oocytes are removed from the ovary and placed in a Petri dish with sperm.

Use the following information to answer the next question.

The effect of a teratogen on an embryo or fetus depends upon the developmental stage of the embryo or fetus when exposure takes place.

Possible Effects of Teratogens on an Embryo or Fetus

- 1 Exposure to teratogens affects growth and maturation of organs that have already been formed.
- 2 Exposure to teratogens causes abnormalities that cannot be repaired because cells are differentiating into tissues and organs.
- 3 Cells have a chance to recover from teratogen exposure because they are undifferentiated and can replace damaged or lost cells through mitosis.

Numerical Response

3. Match each of the effects of teratogens numbered above with the stage of development during which it takes place, as described below.

Effect: _____
Stage: **Conception** **Implantation** **8 weeks to**
 to **to 7 weeks** **38 weeks**
 implantation

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

14. Which of the following rows matches an embryonic germ layer with a tissue that develops from it?

Row	Germ Layer	Tissue that Develops from Germ Layer
A.	Endoderm	Skin
B.	Endoderm	Muscle
C.	Mesoderm	Skin
D.	Mesoderm	Muscle

Use the following information to answer the next two questions.

To produce large rainbow trout for the sport-fishing industry, fish farmers subject fertilized rainbow trout eggs to high pressure. The pressure causes a fertilized egg to fuse with a polar body. The resulting structure develops into a larger-than-normal rainbow trout that is sterile. Normal rainbow trout produce gametes by meiosis.

15. Which of the following rows identifies the ploidy of the fertilized egg before it is subjected to high pressure and the ploidy of the fertilized egg after it is subjected to high pressure?

Row	Ploidy of Fertilized Egg Before Being Subjected to High Pressure	Ploidy of Fertilized Egg After Being Subjected to High Pressure
A.	n	$2n$
B.	n	$3n$
C.	$2n$	$2n$
D.	$2n$	$3n$

Use the following additional information to answer the next question.

A normal rainbow trout has a chromosome number of $2n = 58$.

16. The chromosome number of a polar body from a normal rainbow trout is
- A. $n = 29$
 - B. $n = 58$
 - C. $2n = 58$
 - D. $3n = 87$

Use the following information to answer the next question.

The *IGF2R* gene is involved in the regulation of fetal growth. The protein coded by *IGF2R* suppresses the growth of a fetus.

17. The protein coded by *IGF2R* **most likely** regulates fetal growth by
- A. inhibiting genes that produce proteins required for cell division
 - B. activating genes that produce proteins required for cell division
 - C. inhibiting genes that produce proteins required for cell differentiation
 - D. activating genes that produce proteins required for cell differentiation

Use the following information to answer the next question.

Many amphibians can regenerate limbs that are lost due to injury. During regeneration, cells in the tissue layer adjacent to the injury lose their specialized characteristics and become similar to stem cells. These stem-like cells respond to growth factors and specialize into bone, muscle, and skin cells. When the new limb is fully replaced, “stop signals” prevent the cells from continuing to multiply.

18. Which of the following rows identifies the chromosome content of the stem-like cells that replace the lost limb and the chromosome content of the cells of the new limb?

Row	Chromosome Content of Stem-like Cells	Chromosome Content of Cells of New Limb
A.	Diploid	Diploid
B.	Diploid	Haploid
C.	Haploid	Diploid
D.	Haploid	Haploid

Use the following information to answer the next question.

The species of mouse used in most laboratory studies has a diploid chromosome number of 40.

19. The karyotype of a male mouse of the species used in most laboratory studies would show
- A. 19 pairs of homologous autosomes and one pair of homologous sex chromosomes
 - B. 39 pairs of homologous autosomes and one pair of homologous sex chromosomes
 - C. 19 pairs of homologous autosomes and one pair of non-homologous sex chromosomes
 - D. 39 pairs of homologous autosomes and one pair of non-homologous sex chromosomes
-

Use the following information to answer the next question.

Men with Klinefelter syndrome, a genetic disorder characterized by the presence of an extra X chromosome, are usually infertile.

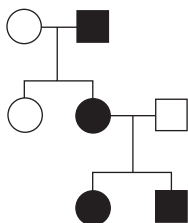
20. The presence of the extra X chromosome in the cells of a man with Klinefelter syndrome results from abnormal
- A. synapsis
 - B. replication
 - C. segregation
 - D. crossing over
-
21. Which of the following statements **best** describes the inheritance of an X-linked dominant disorder?
- A. A man who has the disorder has a 0% chance of passing it on to his son.
 - B. A man who has the disorder has a 50% chance of passing it on to his daughter.
 - C. A woman who is heterozygous for the disorder has a 100% chance of passing it on to her son.
 - D. A woman who is heterozygous for the disorder has a 100% chance of passing it on to her daughter.

Use the following information to answer the next question.

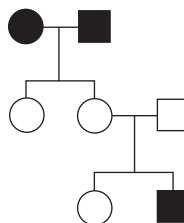
Ehlers-Danlos syndrome is a genetic disorder in which the skin and joints are much more elastic than normal. This disorder is most commonly inherited as an autosomal dominant mutation.

22. Which of the following pedigrees shows the most common inheritance pattern of Ehlers-Danlos syndrome?

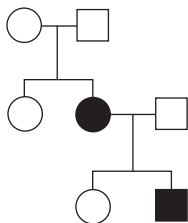
A.



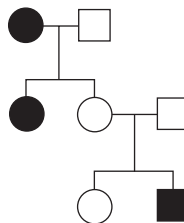
B.



C.



D.



Use the following information to answer the next question.

Phenylketonuria (PKU) is an autosomal recessive disorder that causes a buildup of the amino acid phenylalanine in the blood. Symptoms of PKU include severe mental disability and other neurological problems.

Numerical Response

4. A man who has PKU and a woman who is a carrier of the disorder have a child. What is the probability that their child is also a carrier?

Answer: _____

(Record your answer as a value between 0 and 1 rounded to two decimal places in the numerical-response section on the answer sheet.)

23. Which of the following rows describes DNA and RNA?

Row	DNA	RNA
A.	Contains deoxyribose and adenine	Contains ribose and thymine
B.	Contains deoxyribose and thymine	Contains ribose and uracil
C.	Is a double helix composed of nucleotides	Is a single strand composed of amino acids
D.	Is a double helix composed of amino acids	Is a single strand composed of nucleotides

Use the following additional information to answer the next question.

The insulin protein is 51 amino acids long.

24. The number of base pairs in the gene that codes for insulin is

- A. 51
- B. 102
- C. 153
- D. 306

Use the following information to answer the next question.

Metabolic syndrome is a genetic disorder with symptoms of hypertension, elevated blood cholesterol concentrations, and lower-than-normal blood magnesium concentrations. This syndrome is caused by a mutation in mitochondrial DNA (mtDNA) in which a thymine nucleotide is replaced by a cytosine nucleotide.

25. Which of the following rows identifies the mutated mtDNA and the corresponding mRNA and tRNA produced in a person with metabolic syndrome if the normal mtDNA triplet code is TCG?

Row	Mutated mtDNA	mRNA	tRNA
A.	TTG	AAC	UUC
B.	TCG	UGC	ACG
C.	CCG	GGC	CCG
D.	CCG	GGC	GGC

Use the following information to answer the next two questions.

Human genes were integrated into the chromosomes of pig sperm using the procedure of sperm-mediated gene transfer (SMGT). Scientists think that SMGT will increase the possibility of successful transplantation of organs from pigs to humans, a technique known as transgenic transplantation.

—based on *Nature*, 2003

Nosengo, Nicola. 2003. Piglets add some colour to transgenic story. *Nature* 424, no. 6949 (August 7): 604.

26. The integration of human genes into the chromosomes of pig sperm leads to
- A. fertilization of multiple ova
 - B. stimulation of RNA production
 - C. detection and removal of mutations
 - D. production of human proteins in pig embryos

Use the following additional information to answer the next question.

In the first successful SMGT procedure, scientists used an enzyme to integrate three human genes into the chromosomes of pig sperm. Approximately 90% of the resulting pig embryos carried all three human genes in every cell.

27. The presence of the human genes in every cell of a pig embryo is evidence that the genes went through
- A. DNA replication
 - B. mRNA translation
 - C. mRNA replication
 - D. DNA transcription
-
28. Variation of traits in organisms that reproduce asexually occurs as a result of
- A. segregation
 - B. gene linkage
 - C. random mating
 - D. genetic mutations

Use the following information to answer the next question.

A genetic mutation that causes deafness in humans is the 35delG mutation, which has an autosomal recessive pattern of inheritance. In a population of 235 Turkish children, 48 of the children were homozygous recessive for the 35delG mutation.

—based on Barış et al., 2001

Barış, İ, MO Kılınç, and A Tolun. 2001. Frequency of the 35delG mutation in the connexin 26 gene in Turkish hearing-impaired patients. *Clinical Genetics* 60 (6): 452–455.

Numerical Response

5. What is the frequency of the homozygous recessive genotype in the population of Turkish children described above?

Answer: _____

(Record your answer as a value rounded to two decimal places in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

Female cougars usually reproduce every two years, bearing up to four cubs in a litter. The cubs remain close to their mother for 18 months and depend on her for both food and protection from predators.

29. The reproduction strategy of cougars can be described as
- A. *r*-selected, because females reproduce every two years
 - B. *K*-selected, because parental care increases survivorship
 - C. *K*-selected, because increased competition reduces survivorship
 - D. *r*-selected, because juveniles are dependent for eighteen months

Use the following information to answer the next two questions.

The intense heat from a forest fire stimulates the germination of dormant seeds, which will be among the first plants to grow in the burned area.

30. Which of the following rows identifies the type of succession that occurs after a forest fire and the type of community represented by the first plants that grow in the burned area?

Row	Type of Succession	Type of Community
A.	Primary	Pioneer
B.	Primary	Climax
C.	Secondary	Pioneer
D.	Secondary	Climax

31. By burning vegetation, forest fires help to ensure the survival of the first plants to grow in the burned areas by decreasing
- A. intraspecific competition and increasing density-dependent limiting factors
 - B. interspecific competition and decreasing density-dependent limiting factors
 - C. interspecific competition and increasing density-independent limiting factors
 - D. intraspecific competition and decreasing density-independent limiting factors