

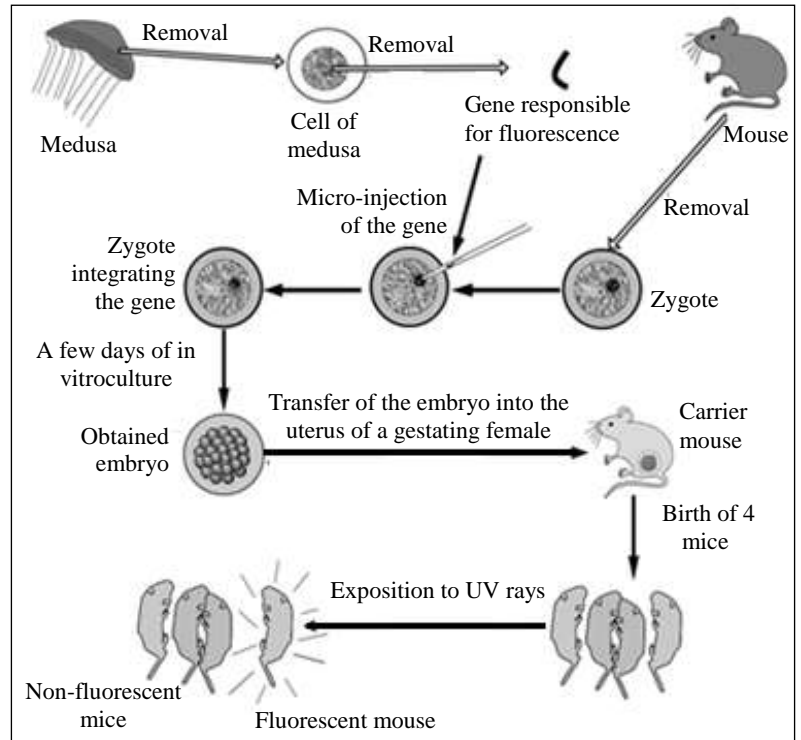
الاسم: مسابقة في الثقافة العلمية  
الرقم: مادة علوم الحياة  
المدة: ساعة واحدة

## Answer the following exercises

### Exercise 1 (5 points) A Fluorescent Mouse

Researchers in Osaka University have succeeded in producing a genetically modified mouse that fluoresces green in darkness. The different steps of this technique are presented in the adjacent document.

Based on this, other Californian scientists have decided to produce fluorescent trees in order to replace street lighting.



- 1- Describe, in a short text, the technique schematized in the adjacent document.
- 2- Indicate the mouse /micethat is/are qualified as Genetically Modified Organism(s). Justify the answer.
- 3- Pick out one environmental application of this technique.
- 4- State two applications of transgenesis in the medical field.

### Exercise 2(5 points)

### Cortisol, Stress Hormone

In order to confront a stressful situation, the organism shows modifications in the physiological function of certain organs involved in this defense by secreting hormones such as cortisol. To determine the conditions of secretion of this hormone, the experiments presented in the table below are performed.

	Initial state of the animal	Performed operation	Exposition to stress	Secretion of cortisol
A	Normal animal	—	+	+
B	Normal animal	Destruction of the cells of the adrenal cortex	+	-
C	Normal animal	Ablation of the pituitary gland	+	-
D	Animal deprived of the pituitary gland	Intravenous injection of a pituitary gland extract, ACTH	+	+
E	Animal deprived of the pituitary gland	Destruction of the cells of the adrenal cortex followed by an intravenous injection of ACTH	+	-

+ : presence - : absence

- 1- Interpret each of the above experiments.
- 2- State two roles of cortisol hormone.
- 3- Name another hormone that is involved in stress. Indicate its role.

### Exercise 3 (5points)

### Effect of Cocaine

Pleasure sensation is related to the activity of dopaminergic neurons in “reward system”. Cocaine, just like most drugs, affects this activity. In order to understand its mode of action, the following experiments are performed.

#### Experiment 1:

Two lots of rats, lot 1 and lot 2, are considered. Rats of lot 2 are injected with cocaine. In both lots, the concentration of dopamine is measured in the liquid surrounding the neurons in a specific region of the cerebrum. The results of measurements done at 0 min (T0) and at 60 min (T1) following the injection are presented in document 1.

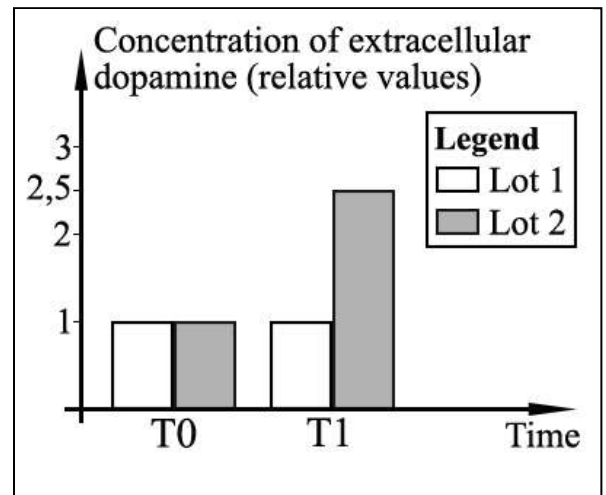
1- Justify the following statement: “cocaine increases the pleasure sensation”.

#### Experiment 2:

Stimulations are applied on a presynaptic excitatory neuron connected to a dopamine neuron. At T1, the frequency of AP of this dopamine neuron, the quantity of dopamine released as well as that recaptured are measured.

The obtained results are presented in document 2.

- 2- Explain the links existing between the different parameters measured in lot 1.
- 3- 1- Compare the results of each of the parameters obtained at T1 for the two lots.
- 3- 2- What can you draw out concerning the mode of action of cocaine?
- 4- Explain why the use of drugs is forbidden and not recommended.



Document 1

	Lots at T1	
	Lot 1	Lot 2
Measured parameters		
Frequency of AP in the dopamine neuron	+++	+++
Quantity of released dopamine	+++	+++
Quantity of recaptured dopamine by the dopamine neuron	++	+
	+ : low	++ : moderate
		+++ : high

Document 2

### Exercise 4 (5 points)

### One Nervous Structure

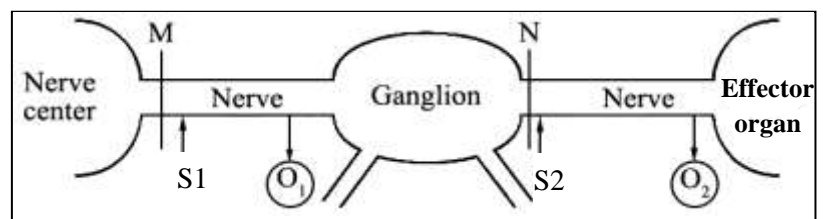
Document 1 shows a part of the nervous system. In order to determine the direction of conduction of the nervous message and the neuronal circuit involved in this part of the nervous system, the following experiments are performed.

#### Experiment 1:

Two receptor electrodes connected respectively to oscilloscopes O<sub>1</sub> and O<sub>2</sub>, and two stimulating microelectrodes, S1 and S2, are placed at the level of the nerve (doc.1).

An effective stimulation is applied at S1, responses are recorded at the level of O<sub>1</sub> and O<sub>2</sub>.

An effective stimulation is applied at S2, a response is recorded at the level of O<sub>2</sub> but not at O<sub>1</sub>.



Document 1

1- Indicate the direction of conduction of the nervous message in this part of the nervous system. Justify the answer.

#### Experiment 2:

The nerve is sectioned at the level of M or N. The obtained results are presented in document 2.

- 2- Knowing that only the sectioned part of a cell that doesn't contain the nucleus degenerates, interpret the results of experiment 2.
- 3- Draw a scheme showing the neuronal circuit involved in this part of the nervous system and indicate by arrows the direction of the nerve message conduction.
- 4- Explain why the nerve message was not recorded at O<sub>1</sub> in the case where the stimulation was applied at S2 (experiment 1).

Level of the performed section	Observed degeneration
M	only between M and the ganglion
N	only between N and the effector organ

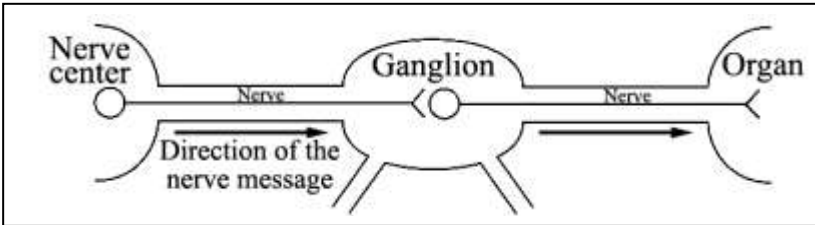
أسس التصحيح

مسابقة في الثقافة العلمية  
مادة علوم الحياة  
المدة: ساعة واحدة

Part	Answer key	Grade
	<b>Exercise 1</b>	
1	A cell is removed from a medusa. Then the gene responsible for fluorescence is removed from the medusa cell and is microinjected in the zygote removed from a mouse. The zygote integrates the gene and after a few days of in vitro culture gives an embryo. The embryo is then transferred into the uterus of a gestating female, carrier mouse. The carrier mouse gave birth to 4 mice that were exposed to UV rays. One of the mice fluoresced and 3 mice did not fluoresce.	1,5
2	The fluorescent mice is qualified as GMO, since it integrates a different (foreign) gene coming from another species (medusa) in its genotype and expresses it in its phenotype (fluorescent skin).	1,5
3	To produce fluorescent trees in order to replace street lighting.	1
4	Production of: insulin, growth hormones, antibodies, vaccine... (2x1/2pt)	1

Part	Answer key	Grade
	<b>Exercise 2</b>	
1	<p>Secretion of cortisol occurs in the normal animal exposed to stress (exp A) while no secretion of cortisol occurs after the destruction of the cells of the adrenal cortex (exp B) or after the ablation of the pituitary gland (exp C) of the normal animal subjected also to stress. This shows that the adrenal cortex and the anterior pituitary gland are implicated in the cortisol secretion.</p> <p>However, in experiment D, there is a secretion of cortisol in the animal deprived of the pituitary gland and that is also subjected to stress, after receiving an intravenous injection of ACTH. This shows that the pituitary gland acts on the secretion of cortisol by releasing ACTH in the blood.</p> <p>While there's no secretion of cortisol in the animal deprived of the pituitary gland and that is also subjected to stress, after receiving an intravenous injection of ACTH following the destruction of the cells of the adrenal cortex (expE). This shows that the pituitary gland acts on the secretion of cortisol indirectly through the adrenal cortex. (4x 3/4pt)</p>	3
2	<p>Cortisol ensures: neoglucogenesis (the catabolism of proteins) , glycogenolysis and lipolysis .</p> <p>Provokes hyperglycemia, reduces inflammatory reactions, renders the blood vessels more sensitive , reduces the consumption of glucose by the body cells except that of the cerebrum. (2x 1/2pt)</p>	1
3	<p>Adrenaline (½ pt) ensures the conversion of glycogen into glucose in the liver. ½ pt</p> <p>Or Acceleration of the cardiac rhythm, vasoconstriction , arterial pressure elevation (hypertension) , increase of the respiratory rhythm , hyperglycemic action , increase of cellular metabolism.</p>	1

Part	Answer key	Grade
	<b>Exercise 3</b>	
1	Dopamine is involved in the pleasure sensation. Document 1 shows an increase of the amount of dopamine in a specific region of the cerebrum from 1 to 2.5 relative values within 60 minutes after the injection of cocaine. Thus the increase of the dopamine concentration in the cerebrum due to the action of cocaine, increases this pleasure sensation.	1
2	The parameters are related to the synaptic transmission of the nerve message coming from the dopamine neuron. The AP propagating through the dopamine neuron reaches the terminal buds of this neuron and stimulates the exocytosis of dopamine contained in the vesicles. The high quantity neurotransmitters released in the synaptic cleft is proportional to the high frequency of AP. These neurotransmitters fix on specific receptors on the membrane of the postsynaptic cell. Then, a moderate quantity of the neurotransmitters is recaptured through the presynaptic membrane.	1
3-1	The frequency of AP in the dopamine neuron and the amount of liberated dopamine are high and identical in both lots. The amount of dopamine recaptured by the dopamine neuron is moderate and higher in lot 1 than in lot 2.	1.5
3-2	Cocaine diminishes the recapture of the dopamine neurotransmitters by the presynaptic neuron.	0.5
4	The use of drugs is forbidden since drugs provoke physical and psychological dependence and causes, at long term, behavioral disturbances and neuronal and/or general toxicity.	1

Part	Answer key	Grade
	<b>Exercise 4</b>	
1	The nerve message is transmitted only from the nerve center towards the organ passing through the ganglion (1/2pt). Since a response is recorded in O1 and O2 when effective stimulation is applied at S1, thus the message passes from the center toward the organ crossing the ganglion. However, since there's no response in O1 while a response is recorded in O2 following the stimulation applied at S2, thus the nerve message is not transmitted from the organ toward the center. (1 pt)	1,5
2	The part of the nerve between M and the ganglion degenerate after the sectioning of the nerve at the level M. This shows that the cell bodies are located in the nerve center.(1/2pt) Similarly, the part of the nerve between N and the organ degenerate after the sectioning of the nerve at the level N. This shows that the cell bodies are located in ganglion.(1/2pt)	1
3	Scheme of the neuronal circuit involved in this part of the nervous system.	1
		
4	The nerve message at the level of the synapse is transmitted in one direction from the presynaptic neuron towards the postsynaptic neuron. In the studied part, the nerve message is transmitted from the center to the organ by a monosynaptic neuronal circuit. The presynaptic neuron is located between the nerve center and the ganglion and the postsynaptic neuron is located between the ganglion and the organ and the synapse is located at the level of the ganglion. Thus the message induced by S2 cannot cross the ganglion toward O1. That's why nothing is recorded at this level when an effective stimulation is applied at the level of S2.	1,5