Next Step TEST PREP

Science Passage Strategy

Today's Info Session

- Welcome to this Info Session!
- Introduction
- Passage 1
- Passage 2
- How Can Next Step Help?
- Questions?

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MCAT

Medical College Admission Test

WHAT IS YOUR NEXT STEP?

Introduction

Hi, I'm Phil!

- MCAT Content writer
- Tutored and taught for 9+ years
- Attended University of Nebraska Medical Center as an MD/PhD student.

✓ In order to communicate, use the Question box.

Exam Overview

- Four sections – three science, one verbal (CARS)
- Science sections all have same format/time constraints
- Passages and discrete questions alternate
- Some math required, but no calculator is provided

Section	Time Allowed	Number of Questions	Question Format
Chemical and Physical Foundations	95 min	59	10 passages, 15 discretes
Critical Analysis and Reasoning Skills	90 min	53	9 passages
Biological and Biochemical Foundations	95 min	59	10 passages, 15 discretes
Psychological and Sociological Foundations	95 min	59	10 passages, 15 discretes

Passage 1

Clivorine is a potent toxic compound extracted from the plant *Ligularia hodgsonii Hook*. Studies suggest that clivorine induces mitogen-activated protein kinase phosphorylation, leading to renal failure. An adverse event associated with short term ingestion of clivorine is the formation of calcified kidney stones comprised of calcium phosphate $Ca_3(PO_4)_2$.

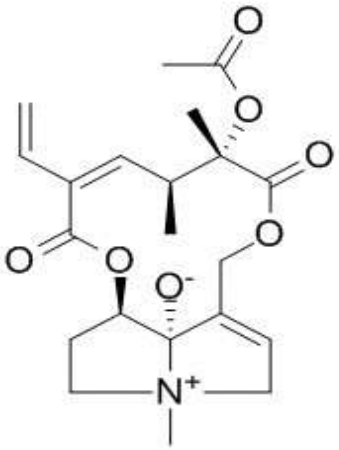

Figure 1 Clivorine

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Passage 1

Researchers wished to study clivorine-treated human kidney K-5 cell growth. K-5 cells were seeded in 96-well microplates at a density of 10^3/well and were treated with clivorine (100 µM) for 12, 24 and 48 h. Then 0.75 mg/ml MTT was added and was incubated with cells for 5 h in a CO_2 incubator. When reduced in a cell, either enzymatically or through direct reaction with biomolecules, MTT turns blue to purple and may form an insoluble precipitate. Formazan dyes are useful for cell proliferation and toxicity assays since they only stain living, metabolically active cells.

At last the cells were dissolved in 10% SDS-0.01 M HCl in a CO_2 incubator for 12 h. The intensity was measured using a reader for ELISA under an absorption wavelength of 570/630 nm (Figure 2).

Passage 1

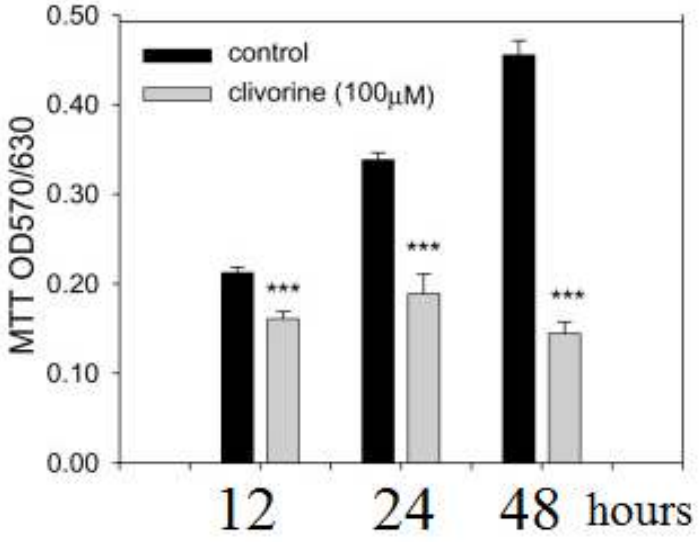

Figure 2 Time course of clivorine on K-5 cells growth. ***$P \leqslant 0.001$ compared with absence of clivorine. Data are means ± SE of three independent experiments

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Passage 1

Next, researchers sought to identify the mechanism of the anti-proliferative function of clivorine in K-5 cells. After 48 h of clivorine (100 µM) treatment, fluorescence-activated cell sorting analysis of cell distribution in K-5 cells was performed as seen in Table 1. Clivorine treatment had no effect on p53 protein levels.

Cell cycle	**Percentage of the cell number**	
	Control	Clivorine (100 µM)
G_0–G_1	50.14 ± 8.37	46.40 ± 4.00
G_2–M	20.11 ± 4.90	20.90 ± 1.32
S	19.80 ± 12.25	22.20 ± 6.36
G_2/G_1	12.00 ± 0.09	11.98 ± 0.01

Table 1 Analysis of cell distribution in K-5 cells after 48 h treatment

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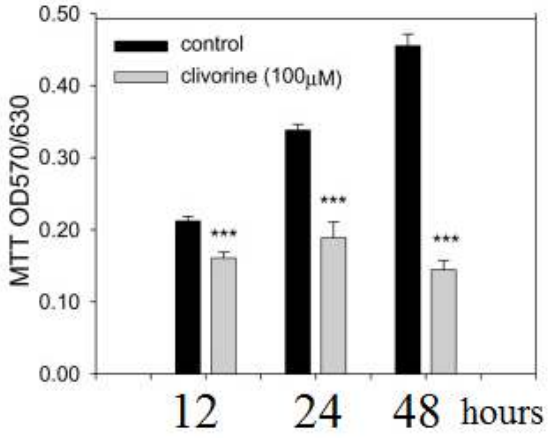
Passage 1

19) The research findings best support which of the following conclusions?

A. Clivorine inhibits human normal kidney K-5 cell mitosis
B. Clivorine induces human normal kidney K-5 cell apoptosis
C. Clivorine reduces p53 protein expression leading to K-5 cell death
D. Clivorine decreases human normal kidney nuclear replication



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Passage 1

20) Which of the following molecules is most likely to cause MTT to turn purple in kidney cells?

A. ATP
B. Cytochrome p450 oxidase
C. NADH kinase
D. NADPH

Passage 1

21) MTT belongs to a class of compounds known as tetrazoles. Which of the following structures would be found in MTT?

A.

B.

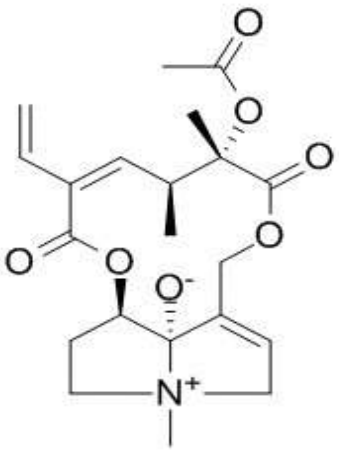
C.

D.

Passage 1

22) Which functional groups are found on clivorine?

A. Ether, ketone, amide
B. Ether, ester, alkyne
C. Ester, amine, alkene
D. Aldehyde, ester, ether



Passage 2

Mesenchymal stem cells (MSCs), which express the marker proteins CD90 and CD109, are stromal cells that, upon terminal differentiation, yield connective tissue cells. Scientists considering the influence of transcription factors on MSC lineage commitment studied the effects of transcription factors thought to be involved in MSC differentiation. They noticed that 14 days after injection of mouse MSCs with a pool of the specific factors, the number of CD109-positive cells declined.

Passage 2

Fibroblast growth factor 2 (Fgf2) has been shown to reversibly inhibit differentiation of mouse MSCs, but the intracellular signaling pathways that maintain this undifferentiated state remain largely unexplored. To further study the effects of transcription factors on MSC differentiation, mouse MSCs were cultured for seven days in complete culture medium (CCM) supplemented with 20 ng/ml Fgf2. Figure 1 shows the effect Fgf2 treatment had on gene expression for the four transcription factors *Gbms1*, *Gbms2*, *Ccnd1*, and *Cpfrd*. Expression was normalized to that found in untreated cells.

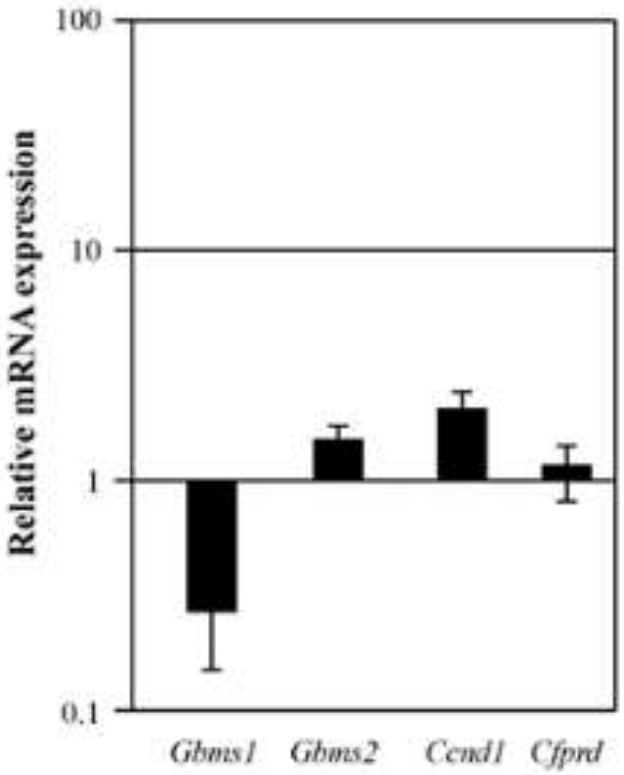


Figure 1 Transcription factor production

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Passage 2

In subsequent experiments, scientists attempted to determine the influence of those four transcription factors in the differentiation of MSC by removing one of the four transcription factors from the four-factor pool and observing the presence of cells testing positive for bone gamma-carboxyglutamic acid protein (Bglap), a connective-tissue specific non-collagenous bone protein, or osteonectin, a component of basement membranes, after 14 days. The results of their measurements are shown in Figure 2.

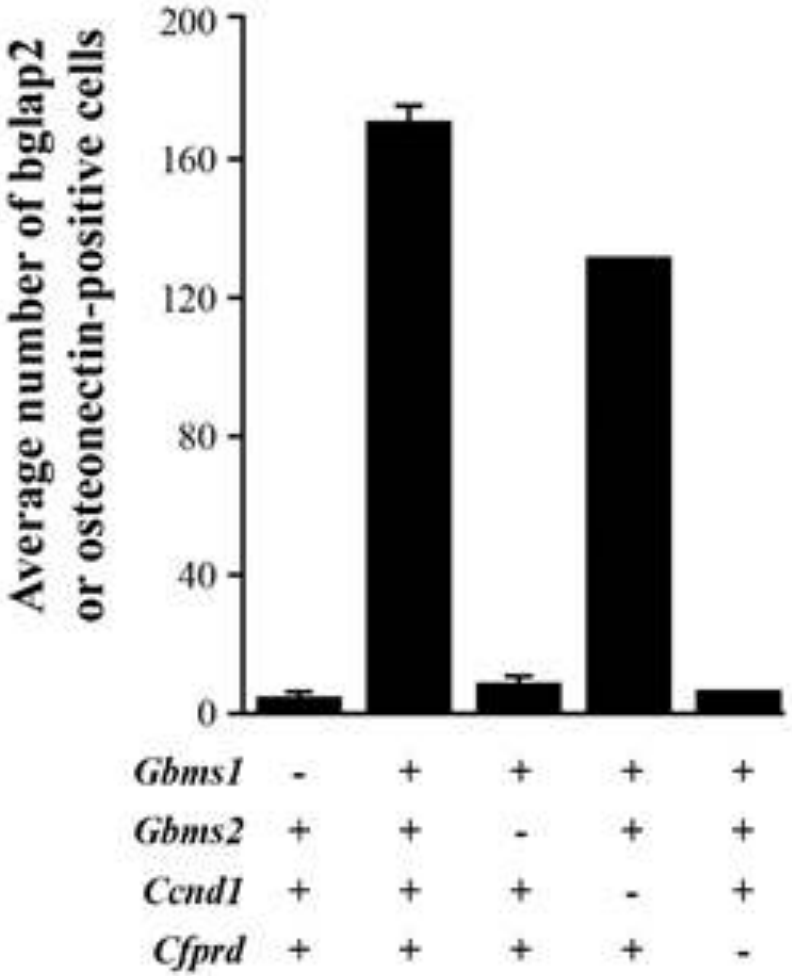

Figure 2 Transcription factors and connective tissue differentiation

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Fgf2 is most likely to inhibit MSC differentiation by modulating the expression of which transcription factor?

- **A.** Gbms1
- **B.** Gbms2
- **C.** Ccnd1
- **D.** Cfprd

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Based upon the results presented in the passage, which of the following factors *least* influenced commitment of mesenchymal stem cells to the connective-tissue lineage *in vitro*?

- **A.** Gbms1
- **B.** Gbms2
- **C.** Ccnd1
- **D.** Cfprd

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What is the most likely reason that the scientists chose to measure Bglap2 levels in assessing the influence of transcription factors on the maintenance of MSCs in the undifferentiated state?

- **A.** Bglap2 is expressed in all cells of mesenchymal origin.
- **B.** Bglap2 is expressed by both connective tissue and mesenchymal stem cells.
- **C.** Bglap2 induces differentiation of MSCs.
- **D.** Bglap2 is expressed by cells with connective tissue-like phenotypes.

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Which column in Figure 2 serves as a positive control for the experiment?

- **A.** Column 1
- **B.** Column 2
- **C.** Column 3
- **D.** Column 4

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Which of the transcription factors tested appears to be necessary to MSC differentiation?

I. *Gbms1*

II. *Gbms2*

III. *Ccnd1*

IV. *Cfprd*

- **A.** I and II only
- **B.** II and III only
- **C.** I, II, and III only
- **D.** I, II, and IV only

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Q&A

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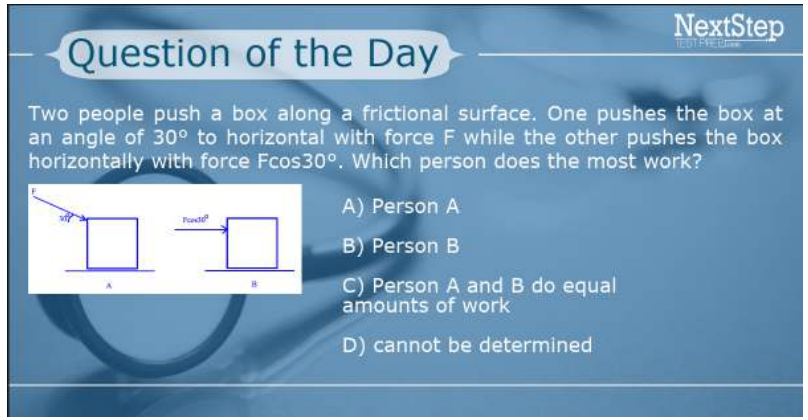

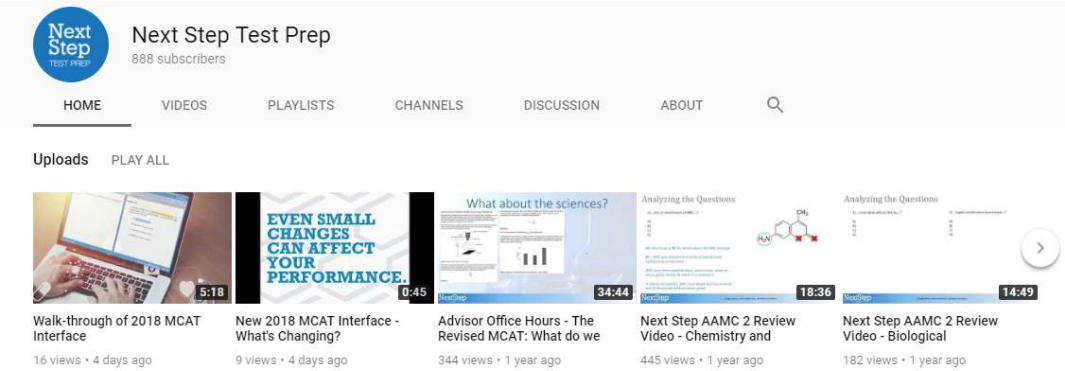

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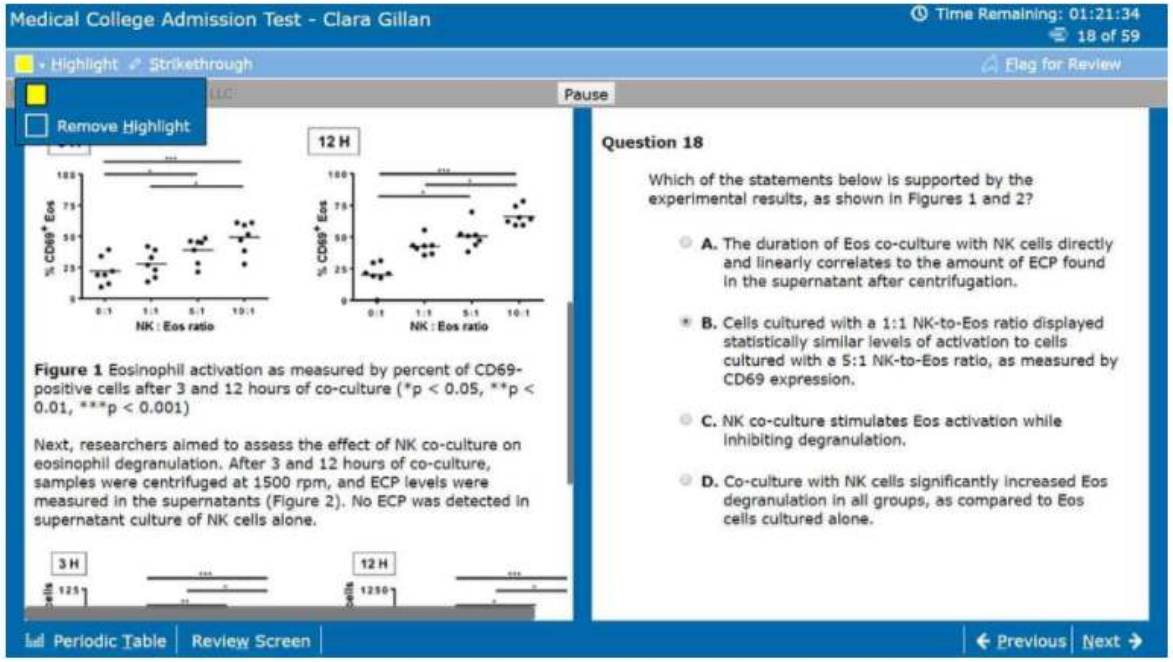

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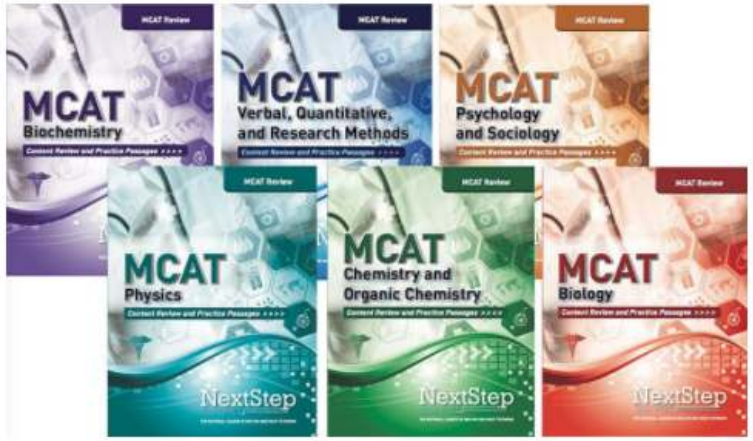

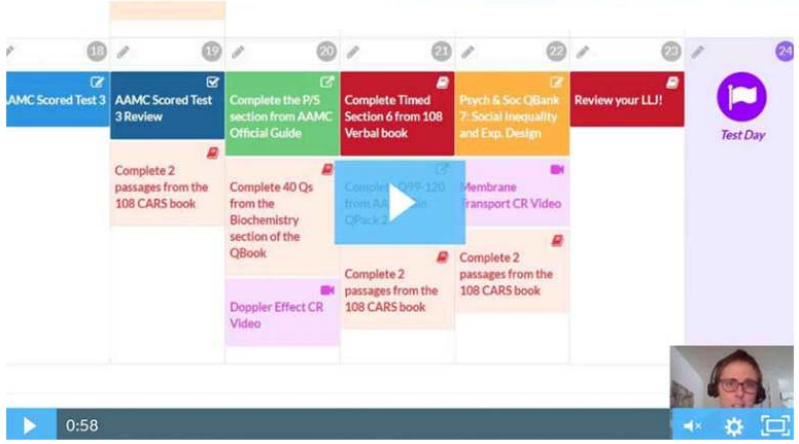

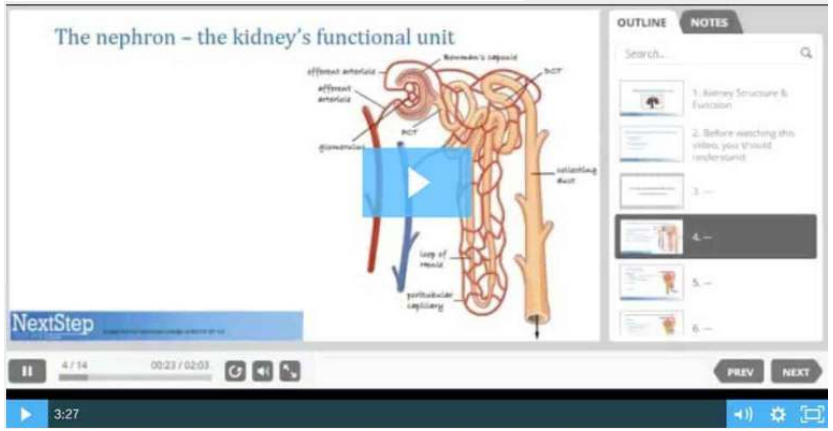

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