**National Student Team Contest (first stage)**
Task 3. Heart studies

Cardiovascular diseases are the most wide-spread pathologies around the world and the main reason of death in most countries. So, it is nor surprising, that the development of new techniques to monitor the state of heart and the synthesis of the new drugs to treat heart diseases attract a lot of attention. One of the main reasons of heart chronic or acute pathologies is the lack of O_2 in heart muscle cells – cardiomyocytes. O_2 is necessary for the function of the respiratory chain in cardiomyocytes' mitochondria and, consequently, ATP synthesis. In its turn, ATP is necessary for the cardiomyocyte contraction. Coronary arteries constantly bring O_2 to cardiomyocytes. Besides, in cardiomyocyte cytoplasm O_2 is bound and stored in myoglobin (Mb) molecules, that release O_2 to mitochondria in conditions of low pO_2 maintaining function of the respiratory chain for some period of time. Deoxymyoglobin (Mb without bound O_2) binds new molecules of O_2 after the restoration of the heart supply with the arterial blood. The figure demonstrates schematically the penetration of O_2 from erythrocytes to cardiomyocyte cytoplasm, mitochondria and binding to Mb.
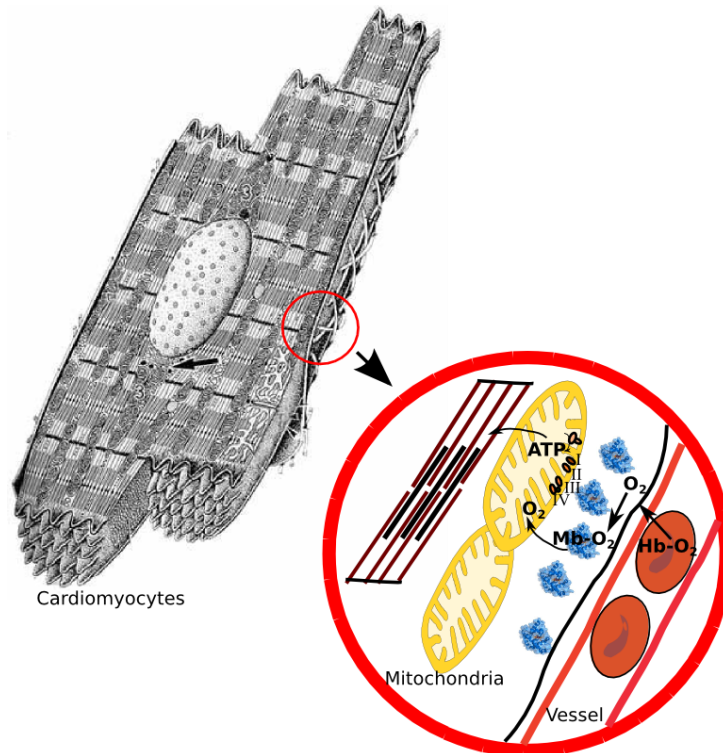
Acute local hypoxia hypoxia (the acute decrease in the amount of oxygen or the complete O_2 absence in blood in coronary arteries) can lead to the death of cardiomyocytes and heart infarction. It is known, that the main processes leading to cardiomyocyte death occur not during the hypoxia period, but during the reoxygenation – restoration of blood supply.

1. Describe the processes occuring in cardiomyocytes and especially in the mitochondrial respiratory chain under hypoxia and after reoxygenation. What happens to the complexes of the respiratory chain (what is the redox state of the electron carriers, etc)? Which processes can lead to apoptosis of cardiomyocytes? **(2 points)**

2. Suggest molecules, which application can facilitate pathological conditions in cardiomyocytes under oxidative stress developing under reoxygenation. Justify your suggestion. **(0.5 points)**

3. Which method/methods can you propose to study redox state of the respiratory chain cytochromes in the intact heart? **(1.5 points)**

4. Suggest the methods to monitor the restoration of cardiomyocyte supply with O_2. **(1.5 points)**

5. Various infections, chronic heart pathologies may lead to the development of the pericarditis. Colchicine is a tested drug that is underthe medical trials for the treatment of pericarditis and other inlammations of the heart tissues. However, colchicine is highly toxic and its oral administration can lead to severe diarrhea in patients. What is the cellular target of colchicine? Suggest the possible design of the colchicine-containing "drug" to decrease the gastrointestinal side-effects. **(2.5 points)**

Total – 8 points