National Student Team Contest (first stage)
Solution of task 5. Blood-brain barrier

1. Blood vessel endothelial cells with tight junctions between them, astrocytic endfeet composing “glia limitans”. Occludin, claudin, etc.

2. Molecules with low molecular weight, many lipophilic molecules are allowed to pass. Some peptides can cross the barrier by means of specialized mechanisms. Large molecules, most hydrophilic molecules are prevented from passage.

3. Meningitis, brain abscesss, epilepsy, Alzheimer’s disease, hypoxia and brain ischemia, brain trauma, rabies, tse-tse fly disease.

4. Timed injection of fluorescent dyes into the blood stream followed by estimation of dye diffusion into the tissue. Accumulation of radio-labeled metabolites in the brain tissue followed by radio-autographing brain sections.

5. Timed injection of gold nanoparticles of different sizes into the blood stream followed by the estimation of gold nanoparticle autofluorescence or Raman scattering in neurons and astrocytes. Different size of nanoparticles allowes to estimate approximate geometrical size of molecules that can pass blood-brain barrier. Au nanoparticles are more preferable comparing to Ag nanoparticles, since their Raman scattering lies in the visible spectral range and their autofluorescence is excited by longer wavelengths, than autofluorescence of Ag nanoparticles. Therefore, laser excitation of Au nanoparticle autofluorescence and Raman scattering is less harmful for nerve cells, than laser excitation of autofluorescence and Raman scattering of Ag nanoparticles. The main artifact is that nanoparticles can penetrate to brain tissues not only through the “holes” in the blood-brain barrier, but also via endocytosis in endothelial cells, that would give an artificial overestimation of the blood-brain barrier penetrability.