

Now that you have studied Chapter 3, Macromolecules, I would like you to answer the following questions in a discussion format and share your answers with the other students in the class.

NASA has just approached you and asked you to help them to design a new experiment for a planned Mars Rover. NASA wants to send a new portable Mass Spectrometer to Mars to look for definitive signs of life. The Mass Spectrometer NASA is planning on building will be able to measure large organic and biological molecules (not just small molecules like methane).

[https://en.wikipedia.org/wiki/Mass\\_spectrometry](https://en.wikipedia.org/wiki/Mass_spectrometry)

Please answer the following questions in your discussion:

1. What macromolecule (you can only pick one) would you choose to search for as a definitive sign of current or past life on Mars?
  2. What would be the maximum molecular weight of the Macromolecule that the Mass Spectrometer should be designed to measure?
  3. If you had limits on molecular weight due to instrumental size, would your answer to question 1 change?
  4. If you found the Macromolecule that you proposed to search for on Mars, how would you convince the scientific community and civilian community that you can definitively state that there is or was life on Mars? How this would change our perspective of life on earth and in the universe.
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1. NASA Mass Spectrometer could be designed to detect the presence of proteins which is prominent in any cells, responsible of many tasks of cellular life, including cell shape and organization. Among the various proteins of the cell, histone is critical in the packing of DNA into the cell, chromatin and chromosomes. There is an overall agreement that Alien DNA will follow terrestrial DNA structure and by extension presence of histone due to its role in DNA will be a string signal of past or future life on Mars.
  2. There are five histone types separated into two groups: the core histone (H3, H4, H2A, and H2B) with a molecular weight ranging from ~11,300 Da to 15,300 Da and the linker histone (H1 and its variants) with a molecular weight range from ~20KDa to 25KDa. So, the mass spectrometer needs to be able to measure a maximum molecular weight of ~ 25KDa.
  3. A limitation on molecular weight has a direct impact on the protein to measure. The standard proteins include 11 proteins from 6.5K to 205K Da, the maximum molecular weight limit is a hard constraint which dictates which proteins could be considered.
  4. if histone is detected it will be a strong indicator of the presence of structural support of DNA. However, it will not be sufficient to affirm with certainty the presence of life in the past or future on Mars. More organic proteins will need to be detected and further analysis will have to be performed.