TEACHER NOTES – ASTRONOMY IN THE NEWS #44

ANCIENT LIFE ON MARS

Slide 2 – Background Science: Ancient Mars

The surface of Mars used to be a lot different than to how we see it today. A period called the Noachian, which occurred 3.7 – 4.1 billion years ago contained a lot of geological features which have shaped the current surface of the planet. It is this time period, for example, when a lot of impact craters that are found on the surface (along with those on the Moon) were made. On Earth, it is when life is first thought to have arisen.

In this period, water was thought to be in abundance on the surface of the planet. There is evidence for riverbeds, lakes, and other water formations. Along with this, the entire Northern hemisphere, which is lower lying than the South, is thought to have housed an ocean. The atmosphere was much thicker than the current one, with a thicker atmosphere which could have sustained rainfall. The atmosphere is thought to have had a carbon dioxide abundance 10 times of that which is found today. This change in the atmosphere is thought to have started around the time that the bombardment from asteroids that caused the impact craters stopped.

IMAGES:

1. (Left) Artist's impression of Mars during the Noachian period. The river structures in the Southern hemisphere are visible, as is the large ocean that covers the majority of the Northern hemisphere.
2. (Right) Image of the Kodiak butte, located in the Jezero Crater, a site visited by rovers as it shows possibly signatures of past surface water. A butte is a flat-topped hill which is isolated. This image is taken from a distance of approximately 2.24 km. Similar features are found on Earth, usually in deltas at the mouths of rivers.

Slide 3: Early Martian Life

Life on Earth comes in many shapes and sizes, and the majority of it is too small for us to see with our eyes. If life does exist on Mars, or did in the past, the chances are it is of the microbial form.

One place that life could have thrived on the early Mars was under the crust. The regolith, the loose matter like dust and small stones on top of a stone surface (like seen on the Moon), would have been saturated by a brine-like liquid. This surface, or more specifically, underneath it, would have sheltered microbial life from ultraviolet light and cosmic rays, allowing it to thrive. These microbes, called methanogens, would have consumed H_2 and CO_2, producing methane as a waste product. This life would have been as active as that on Earth at the same time. However, that was the problem! This amount of life would have caused a significant composition shift of the atmosphere by the over production of methane. This would have compromised the surface habitability and forced any potential

life deeper into the crust. The most likely places for these would have been around the equator, at low-to-medium latitudes. These regions would be the best places to search for past life, and are consistent with where current missions have visited.

The article that this week's bulletin is built on can be found here:

https://www.theguardian.com/science/2022/oct/10/ancient-mars-could-have-been-teeming-with-microbial-life-researchers-find

There is, unfortunately, no free version of the research article that can linked to here.

IMAGES:

1. (Top left) This map of Mars effectively shows the elevation. The colour is related to the temperature at which the brine solution would have frozen at. This occurs at a low temperature here with darker colours showing low probability of surface ice. This means that the life would have existed in the crust. The more ice on the surface, the less widespread life would have been. The white points are the most likely points where life would have existed, the lakes during the Noachian period.
2. (Bottom left) The minimum depth of the microbial life as a function of longitude and latitude on Mars. Red indicates 0-0.5 km, whereas dark blue is 2km. The highest elevation points show the least depth, possibly due to the higher probability of ice occurring.
3. (Right) Change in surface air pressure as a function of time over the lifetime of Mars. When originally formed, the pressure was approximately the same as Earth, and has steadily dropped to 0.01 of the pressure that Earth has. At the time of the Noachian period, it was approximately a tenth of the present-day Earth.

Slide 4 – Activity: Was there water on Mars?

This task is simply, which image is Earth and which is Mars. On the slide are two photographs of landscape on each of the planets. They both show the same geological phenomenon. When a lake dries out, cracks appear, and these appear as polygon shapes, and the same features are observed on Mars. The question for the students is, which is which, and do they think it's evidence for water on Mars? (Right hand side is Mars)

GCSE Specifications:

Specification	Knowledge Point
Pearson Edexcel Astronomy	11.1