TEACHER NOTES – ASTRONOMY IN THE NEWS #17
MARS LIFE AND THE JEZERO CRATER

Slide 2 – Background Science: Mars vs. Earth

One piece to the puzzle of understanding the past evolution of Earth is understanding how Earth evolved differently to similar planets. The most similar planet to Earth in the Solar System is Venus. Venus has a similar size, mass, density and surface gravity. Mars also has similarities, such as the length of day is almost identical, along with the tilt of the axis. However, the most striking similarity between Mars and Earth is the existence of water, in the form of ice and water vapour. The poles of Mars have a significant amount of ice, containing 3.2 million cubic km of ice, which is comparable to the amount of ice on Greenland. Considering the smaller size of Mars compared to Earth, where Mars has a surface area 3.5x smaller, 2x smaller radius, and 6x smaller volume, the total amount of ice on Mars (5 million cubic km) would result in a 35m layer of water across the planet if melted.

The existence of water, especially in liquid form could signify the existence of life. Mars has evidence that there was once liquid water (see the next slide).

IMAGES:

1. (Left) Comparison of the sizes of Earth and Mars, showing that Mars is almost half the size of Earth, in terms of radius.
2. (Top right) Comparison of the makeup of atmospheres between Mars and Earth. The difference is stark in that Mars is 96% carbon dioxide, compared to the trace amounts on Earth, whilst the majority is nitrogen, with a significant fraction of oxygen.
3. (Bottom right) Image of the south pole of Mars, displaying the ice cap. This ice cap is 400 km across.

Slide 3: Jezero Crater

The Perseverance rover landed on Mars in February 2021, and more specifically landed in the Jezero Crater. This crater was thought to be an ancient lake, a feature that was long lived (1 to 10 billion years) 3.5 billion years ago. The existence of a lake may ensure that it was once where life had time to develop on Mars before the climate changed and didn't allow for the existence of liquid water on the surface.

Within the Jezero Crater is an elevated feature, that was thought to be a delta. However, until images were taken from the surface, it was unclear whether this feature was actually a delta, or if it was a fan. These features are related in that they are the deposits of sedimentary material from a flowing body of water. However, a fan occurs from the deposits of flash floods, whereas a delta is formed when a river arrives at slower moving (or still) bodies of water, such as a lake or an ocean.

These images revealed confirmation of a delta. These were identified from the three broad layers visible, bottomsets, foresets and topsets. The bottomsets are the horizontal layered sediments that are deposited by rivers and flows. The foresets are diagonal, and are the result of material falling down the face of the delta as it got larger, whilst the topsets are horizontal layers above this. These are deposited after the delta has formed, and are covered in boulders, usually carried by more violent events such as flash floods.

The implication of this result is that those bottomsets would have spent a significant amount of time under water, and as a result, biological activity could have thrived. One of the goals of Perseverance is to collect rock samples, which will eventually be collected and returned to Earth for analysis in a future mission. By determining that the Jezero Crater was once a lake, with river activity, it makes the rock samples in these bottomsets highly promising for detecting signatures of past lifeforms on Mars.

The articles that this resource is built on can be found here:

https://www.bbc.co.uk/news/science-environment-58852236

https://www.theguardian.com/science/2021/oct/07/new-images-from-mars-will-guide-search-for-evidence-of-ancient-life-says-study

IMAGES:

1. (Top left) A delta formation from Earth, showing similar features to that of Kodiak in the Jezero Crater on Mars. This delta is found on the Sinai Peninsula in Egypt.
2. (Top right) Image of the Kodiak butte. A butte is a flat-topped hill which is isolated. This image is taken from a distance of approximately 2.24 km.
3. (Bottom) A zoomed in image of the feature in the top left on Kodiak butte. This image shows the bottomset, foreset and topsets visible in this structure. The bottomsets are the horizontal layers at the bottom of the feature, whilst the foresets are in the box labelled “F.” and the topsets are the horizontal layers with the arrows pointing at them. They are labelled truncations, as this is the truncation of erosion. This indicates a change in deposit method, from the river flowing to possible flash floods which would deposited the larger rocks and boulders.

Slide 4 – Activity: Mars or Earth?

This activity is for the students to look at two landscape images, one of Earth and one of Mars, and decide which is which. The Earth image is taken of the desert in the South of Morocco. The Mars image was taken by the Spirit rover from a NASA mission to the planet.

The image on the left is Earth, and the only tell-tale sign that is Earth is that the hue in the sky is blue, which is caused by the atmosphere on Earth.

GCSE Specifications:

Specification	Knowledge Point
Pearson Edexcel Astronomy	11.1, 11.6, 11.26, 11.27