verifica la comprensione

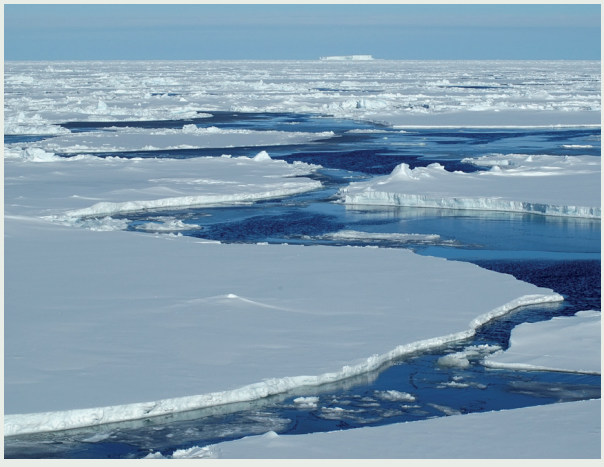
Leggi il brano e rispondi alle domande.

Can life exist without water?

Water and life are closely linked. Liquid water is required for life to start and for life to continue. No enzymes work in the absence of water molecules. No other liquid can replace water. We are very fortunate, therefore, that our planet is so well endowed. Water is a common material in the Universe, being found as widely dispersed gaseous molecules and as ice in tiny grains and much larger asteroids, comets and planets, but water needs particularly precise conditions to exist as a liquid as it does on Earth. It is most likely that this water arrived from multiple sources, such as comets and asteroids, somewhat after solid planet Earth was formed.

The anomalous properties of water are those where the behaviour of liquid water is quite different from what is found with other liquids. Frozen water (ice) also shows anomalies when compared with other solids. Although it is an apparently simple molecule (H_2O), it has a highly complex and anomalous character due to hydrogen bonds between its molecules. As a gas, water is one of lightest known, as a liquid it is much denser than expected and as a solid it is much lither than expected when compared with its liquid form.

As liquid water is so common-place in our everyday lives, it is often regarded as a «typical» liquid. In reality, water is most atypical as a liquid, behaving as a quite different material at low temperatures to that when it is hot. It has often been stated that life depends on these anomalous properties of water. In particular, the high cohesion between molecules gives it a high freezing and melting point, such that us and our planet is bathed in liquid water. The large heat capacity, high thermal conductivity and high water content in organisms contribute to thermal regulation and prevent local temperature fluctuations, thus allowing us to more easily control our body temperature. The high latent heat of evaporation gives resistance to dehydration and considerable evaporative cooling. Water is an excellent solvent due to its polarity and small size, particularly for polar and ionic compounds and salts. It has unique hydration properties towards biological macromolecules (particularly proteins and nucleic acids) that determine their three-dimensional structures, and hence their functions, in solution. This hydration forms gels that can reversibly undergo the gel-sol phase transitions that underlie many cellular mechanisms.



At 4 °C water expands on heating or cooling. This density maximum together with the low ice density results in the necessity that all of a body of fresh water (not just its surface) is close to 4 °C before any freezing can occur, the freezing of rivers, lakes and oceans is from the top down, so permitting survival of the bottom ecology, insulating the water from further freezing, reflecting back sunlight into space and allowing rapid thawing, and density driven thermal convection causing seasonal mixing in deeper temperate waters carrying life-providing oxygen into the depths. The large heat capacity of the oceans and seas allows them to act as heat reservoirs such that sea temperatures vary only a third as much as land temperatures and so moderate our climate (for example, the Gulf stream carries tropical warmth to northwestern Europe). The compressibility of water reduces the sea level by about 40 m giving us 5% more land. Water's high surface tension plus its expansion on freezing encourages the erosion of rocks to give soil for our agriculture.

(www1.lsbu.ac.uk)

a) Why doesn't the water found elsewhere in the universe promote the presence of life forms as it does on Earth?
b) Why is water anomalous when compared with other liquids? What is the cause of these anomalies?
c) In what way does water help make it easier to control our body temperature?