1 Give one piece of conclusive evidence that the whole of the Earth is moving (Earthquakes do not move the whole Earth.)

- Foucault's pendulum
- Coriolis effect
- Stellar parallax
- Aberration of starlight

2 Why are there big, gaseous planets like Jupiter and smaller rocky planets like Earth?

In the disk from which the planets formed, the parts of the disk closer to the sun were hotter than the parts farther out. Close to the sun, materials like water, carbon dioxide and hydrogen gas are heated and pushed out by solar wind and radiation and not able to form planets. The materials left to form planets in the inner solar system were rocky and metallic materials that have much higher boiling points and could remain solid in the inner system. Since the gaseous material is cleared out, there is less material out of which to form the inner planets. The outer planets are far enough out that gaseous materials survive.

3 The Sun is very bright and produces a lot of energy. How does the Sun generate this energy? (Hint: there is a very famous equation that is key.)

The sun generates energy by fusing Hydrogen in Helium, since there is a small amount of mass difference between these two, a tremendous amount of energy is released. The key to understanding this process is Einstein's famous equation, \( E = mc^2 \), which says that for a mass change, \( m \), the energy, \( E \), produced is the product of mass * speed of light squared ( \( c^2 \)).

4 Hubble pictures show stars of different colors. Why do stars have different colors?

Stars are blackbodies, which means that they “glow” with light. The hotter the blackbody, the more light they produce at all wavelengths and the larger a fraction of energetic light they produce. Since blue light is more energetic than red light, a hotter star will be bluer than a cooler (hence redder) star. This is light a candle flame, where the hottest part of the flame is blue and the coolest part is red.

5 If the universe is infinite, and there are stars in every direction, then why aren't there stars visible everywhere in the sky?

This is called Olber's paradox. The resolution to this paradox is that light has a finite travel time and the universe has a finite age. Imagine a star born right at the beginning of the universe 13.7 billion years ago (not really possible). The light from this star could reach us only if this star was located in space less than 13.7 billion light-years (a distance) away. If it was farther than 13.7 billion light-years away then the light would not have had time to reach us.