OCR 21st Century Core Science – Physics P1

THE EARTH IN THE UNIVERSE

P1.1 What do we know about the Earth and Space?

- recall that rocks provide evidence for changes in the Earth (erosion and sedimentation, fossils, folding, radioactive dating, craters);
- understand that continents would be worn down to sea level, if mountains were not being continuously formed;
- understand that the rock processes seen today can account for past changes;
- understand that the Earth must be older than its oldest rocks, **which are about 4 thousand million years old**;
- label on a given diagram of the Earth its crust, mantle and core;
- recall that the solar system was formed over very long periods from clouds of gases and dust in space, **about 5 thousand million years ago**;
- distinguish between planets, moons, the Sun, comets, asteroids and be aware of their relative sizes and motions;
- recall that fusion of hydrogen **nuclei** is the source of the Sun's energy;
- understand that all chemical elements larger than helium were made in earlier stars;
- discuss the probability and possible consequences of an asteroid colliding with the Earth, including the extinction of the dinosaurs;
    - in relation to the above, or when provided with relevant additional information:
    - can identify statements which are data and statements which are (all or part of) an explanation;
    - can recognise data or observations that are accounted for by (or conflict with) an explanation;
    - can identify imagination and creativity in the development of explanations;
    - can justify accepting or rejecting a proposed explanation on the grounds that it:
        - accounts for observations;
        - **and/or provides an explanation that links things previously thought to be unrelated;**
        - **and/or leads to predictions that are subsequently confirmed.**
- recall that light travels at a high but finite speed, **300 000 km/s;**
- understand that the speed of light means distant objects are observed as younger than they are now;
- recall a light-year is the distance travelled by light in a year;
- compare the relative ages of the Earth, the Sun and the Universe;
- compare the relative diameters of the Earth, the Sun and the Milky Way;
- relate uncertainty in the distance of stars and galaxies to the difficulty of observations.

P1.2 How have the Earth's continents moved, and with what consequences?

- recall Wegener's theory of continental drift and his evidence for it (geometric fit of continents and their matching fossils, mountain chains, and rocks);
- understand how Wegener's theory accounted for mountain building;
- recall reasons for the rejection of Wegener's theory by geologists of his time (movement of continents not detectable, Wegener an outsider to the community of geologists, too big an idea from limited evidence, simpler
- explanations of the same evidence);
- understand that seafloor spreading is a consequence of movement of the solid mantle;
- **recall that seafloors spread by about 10 cm a year;**
- **understand how seafloor spreading produces a pattern in the magnetism recorded in ocean floors, limited to reversals of the Earth's magnetic field and solidification of molten magma at oceanic ridges;**
- recall that earthquakes, volcanoes and mountain building generally occur at the edges of tectonic plates;
- **understand how the movement of tectonic plates causes earthquakes, volcanoes, mountain building and contributes to the rock cycle;**
- recall some actions that public authorities can take to reduce damage caused by geohazards.

P1.3 What is known about stars and galaxies?

- understand that what we know about distant stars and galaxies comes only from the radiation astronomers can detect;
- understand that distance to stars can be measured using the relative brightness of stars or parallax (qualitative idea only);
- understand that light pollution interferes with observations of the night sky;
- recall that the Sun is a star in the Milky Way galaxy;
- recall that there are thousands of millions of galaxies, each containing thousands of millions of stars, and that all if these make up the Universe;
- recall that all stars have a life cycle;
- recall that astronomers have detected planets around some nearby stars;
- understand that, if even a small proportion of stars have planets, many scientists think that it is likely that life exists elsewhere in the Universe;
- recall that no evidence of alien life (at present or in the past) has so far been detected;
- recall that distant galaxies are moving away from us;
- **relate the distance of galaxies to the speed at which they are moving away; (Hubble's law, but not redshift)**
- **understand why the motions of galaxies suggests that Space itself is expanding;**
- recall that the Universe began with a 'big bang' about 14 thousand million years ago;
- understand why the ultimate fate of the Universe is difficult to predict.

P1.4 How do scientists develop explanations of the Earth and Space?

- in relation to movements of the Earth's continents or what is known about stars and galaxies or when provided with relevant additional information:
    - can identify statements which are data and statements which are (all or part of) an explanation;
    - can recognise data and observations that are accounted for by, (or conflict with), a given explanation;
    - can identify imagination and creativity in the development of an explanation;
    - can describe in broad outline the 'peer review' process, in which new scientific claims are evaluated by other scientists;
    - can recognise that new scientific claims which have not yet been evaluated by the scientific community are less reliable than well established ones;
- in relation to movements of the Earth's continents or when provided with relevant additional information:
    - can justify accepting or rejecting a proposed explanation on the grounds that it:
        - accounts for observations;
        - **and/or provides an explanation that links things previously thought to be unrelated;**
        - **and/or leads to predictions that are subsequently confirmed;**
    - can draw valid conclusions about the implications of given data for a given explanation, e.g.
        - recognises that an observation that agrees with a prediction (derived from an explanation) increases confidence in the explanation **but does not prove it is correct**;
        - recognises that an observation that disagrees with a prediction (derived from an explanation) indicates that either the observation or the prediction is wrong, **and that this may decrease our confidence in the explanation**;
    - can identify a scientific question for which there is not yet an agreed answer, and suggest a reason why;
    - can identify absence of replication as a reason for questioning a scientific claim;
    - **can explain why scientists regard it as important that a scientific claim can be replicated by other scientists;**
    - can suggest plausible reasons why scientists involved in a scientific event or issue disagree(d);
    - **can suggest reasons for scientists' reluctance to give up an accepted explanation when new data appear to conflict with it.**