IOP Physics Hub-99 **Notes & Resources** **250424**
Theme of Hub-99 ***Biophysics***

1. Overview

The current Physics syllabus mentions; eye defects, hearing impairment, ECG and diagnostic imaging. Some sample exam questions were shown, but references to Biological contexts have been relatively rare in the past but may be more common in the new specification.
Defibrillators (AED) featured on one exam paper. AEDs enable a person in cardiac arrest to have a controlled electric shock administered to their heart using electrodes, if needed.
A sample electro-cardio-graph (ECG) was shown also, and attention was drawn to the vertical axis in milli-Volts and the horizontal axis, measuring Time in seconds. Some uses of ultrasound were listed as; monitoring pregnancy, cardio imaging and breast-check imaging.

2. Dr. Jennifer Gaughran presentation: What would happen to a giraffe on the moon?

Jennifer said that Physics explains how the eyes and ears of humans, work. Physics also explains how body fluids move. There are 2 major fluid systems in the human body:
1. Blood in the heart and circulatory system
2. Air in the lungs and respiratory system

Jennifer drew attention to the fact that fluids embrace gases as well as liquids. Fluid motion is most often determined by differences in pressure (though some other factors like diffusion can play a part). She pointed out that Newton's 2nd law of motion combines with the definition of Pressure to give us the formula $P = \boldsymbol{\rho g} h$.
At sea level on Earth (0°C) the air pressure is 1 atmosphere (1 atm) or 101,325 Pa, which is the pressure exerted by the air column above it. The same pressure is exerted by 760 mm of Hg (mercury) or 1,033 cm of water.

Blood pressure is commonly reported in mmHg, as in 120/80, which means that the systolic and diastolic pressures are, respectively, 120mmHg and 80mmHg.
Pressure is often referenced to atmospheric pressure. A blood pressure of 120 mmHg really means an absolute pressure that is 120 mmHg pressure above atmospheric pressure (with 1atm = 760mmHg).

This is called a gauge pressure $P_{gauge} = \rho gh$

$$P_{gauge} = P_{abs} - V_{atm}$$

A blood pressure of 120/80 generally refers to someone lying down. When you stand upright, there is an additional pressure **ρgh**, where h is the height relative to the heart. This pressure drop is strongly affected by gravity so this pressure difference in outer on other planets would be different. One manifestation of this effect of gravity is potential fainting when you stand.
So how does this affect a giraffe on the moon? Jennifer then solved 3 mathematical problems:
Q1 How far down below sea-level can a person swim before their eardrum will burst?
Q2 How would the pressure in the brain of a giraffe change on the moon?
Q3 You are lying down and are injured in such a way that blood from a major artery squirts upward. How high can it spurt?
The solutions to these problems and Jennifer's slide presentation will be emailed to attendees.