Suggested solution

Activity 1
Wavelengths (nm) dips worth recording 656 (H), 589 (He, Na), 540, 536, 532, 526, 517, 502 (He), 491, 486 (H), 431 (H), 397, 393.

- Gas atoms of different elements present in the outer layer of the sun absorb photons with frequencies corresponding to the energies they need to transit from a lower energy to a higher energy state causing excitation.
- When atoms de-excite, photons are emitted in all directions and not necessary towards the Earth. The intensity of the corresponding wavelengths in the continuous spectrum through the grating is lowered which resulted in the formation of "dark lines".

Activity 2.1
~ 589 nm
- Discrete energy levels in atom
- Energy is transferred by external means to excite the atoms.
- Excited atoms are unstable and de-excite to ground state by emitting photon(s).
- The emitted photons' frequency depends on the energy difference between the initial energy state E_i (of higher energy value) and final energy state E_f (of lower energy value) given by $hf = E_i - E_f$

Activity 2.2
~ 502 nm, 589 nm

Activity 2.3
~656 nm, 486 nm, 431 nm

Use the 3 data above to obtain an average Rydberg constant ~1.1×10^{7} m^{-1}

Students need to understand that Rydberg Formula is obtained from the energy difference between $n > 2$ and $n = 2$. Hence multiple both sides by hc gives a energy conservation relation. The part of the formula related to $1/2^2$ refers to the energy of $n = 2$. Therefore $E_2 = hcR_H/2^2 = 3.4$ eV.

It is therefore not difficult to conclude that $E_1 = hcR_H \sim 13.6$ eV

Using formula E = hf to obtain $E_3 = -1.5$ eV, $E_4 = -0.85$ eV, $E_5 = 0.54$ eV

Activity 2.4
The absorption lines at 431, 486 and 656 nm shows presence of H
The absorption lines at 589 (not conclusive) and 502 nm shows He
The absorption line at 589 nm may indicate Na