**Geos 474/574 Geochronology and Thermochronology, Fall 2019**  
**PS1, Short limbering-up exercise. Due Wed 4 September in class.**

Using the information below and supporting information available in handouts and books, answer the following questions. Suggested units for each answer are provided [in brackets]. a [\text{=}] years.

$^{40}$K is a naturally occurring radioactive isotope that enjoys branched decay to $^{40}$Ar via electron capture with $\lambda_e = 0.581 \times 10^{-10}$ a$^{-1}$, and to $^{40}$Ca via beta decay with $\lambda_\beta = 4.962 \times 10^{-10}$ a$^{-1}$. The speed of light is 2.9979 x $10^8$ m/s. An average human body has a mass of 70 kg and is 0.2% K by mass. A typical coal-burning power plant produces 1 GW.

1a. How much energy is released from the decay of $^{40}$K to $^{40}$Ar, and from the decay of $^{40}$K to $^{40}$Ca? [J/mol] (*Disregard electrons being lost or gained during decay*). (4)

1b. How many atoms of $^{40}$K will decay per year in an average human body? [atoms/a] (3)

1c. How much energy is released (in the form of heat) in an average human body per year from decay of $^{40}$K? [J/a] (3)

1d. If we could capture all this energy and convert it to electrical energy, how much power could we produce per person? [W] (3)

1e. How many folks would it take to replace a typical coal-burning power plant? [number of folks]. (3)

1f. Do you think this raises any potential solutions to the looming energy crisis? Why or why not? [yes or no, and some rationale]. (2)

2. Below is a portion of the Chart of the Nuclides. Grey boxes denote stable or long-lived nuclides.

2a. Label each row with its neutron number. Label each column with its proton number. Label each grey box with the atomic mass number. (5)

2b. Label each grey box with an s if it can be produced by the s-process, an r if it can be produced by the r-process, and a p if it can only be produced by the p-process. (5)