1.3 The greens we eat

Problem 1.3 *The net primary productivity is the amount of elemental carbon that is converted from CO_2 to carbon containing molecules each year and is $14.7 PgC$ (Peta gramms of carbon) per year. If the energy content of dry biomass is 1.6×10^4 $J\ g^{-1}$ (note J≡joule, which is a unit of energy, see Appendix D) what fraction of the total annual plant growth on Earth was eaten by humans in 2008?*[1]

[1] The worlds population was 6.7×10^9 in 2008

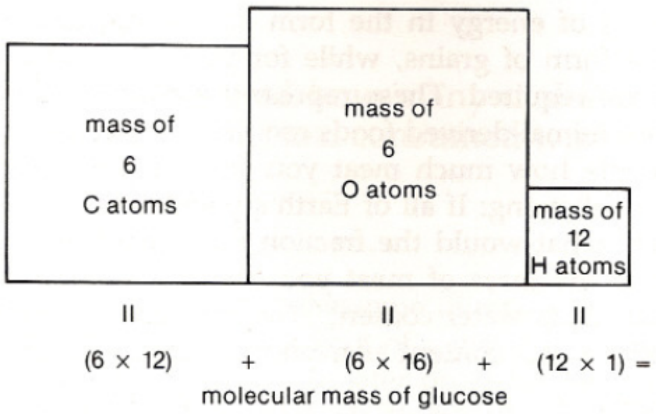

Figure 1.2: The molecular mass of glucose ($C_6H_{12}O_6$) is calculated by adding together the mass of 6 carbon atoms (6 ×12), 6 oxygen atoms (6 ×16), and 12 hydrogen atoms (12 ×1).

You will have to estimate how much energy a typical human eats (e.g. per day). Discuss this with and how you will use it with your group.

1.3.1 Notes

1.3.2 Related problems

1. A formula representing the approximate chemical composition of typical dry freshly photo synthesized biomass is H_{2960} O_{1480}, C_{1480}, N_{160}, P_{18}, S_{10}, where each subscript denotes the relative number of atoms of that elemental type. If this more precise representation is used instead of $C_6H_{12}O_6$, recalculate the fraction, f, of the biomass that must be burned.
2. The production of animal-derived foods, such as beef, eggs, fish, and milk, requires the production of plants as fodder. To produce 1 J of energy in the form of beef requires about 8 J of energy in the form of grains, while for poultry about 3 J of energy from grains are required. These represent extremes. The production of 1 J of other animal-derived foods requires very roughly 5 J of plant matter. Lets say that people on average eat a diet of $1/4$ poultry, $1/5$ beef, $1/5$ other and $7/20$ veg what would the fraction f be? (Hint: first consider how much energy would be required to provide a diet of all poultry use the total energy consumed by humans calculated above).
3. About what fraction of Earth's current npp would we need to consume if we derived all the energy we now (2008) get from fossil fuel (roughly 5×10^{20} J) from biomass instead? What does your answer tell you about the wisdom of replacing all fossil fuels with biomass? What ecological problems would you anticipate this might cause?
4. If the human population continues to grow at about 2%/yr, in what year will humans be eating at Earth's current rate of npp?

1.3.3 Notes on related problems

1.3.4 Homework and reading

Background reading:

- Review appendix C.
- Read appendix D in this booklet.
- Croft and Davison (2006, chapter on 'Transposing formulae') OR 2.7, 2.8. 2.9, 2.10, 2.11 and 2.12 of the *Foundation Maths Support Pack*

Do this weeks assessment on Blackboard:

- 'Transposing formulae'.
- 'The greens we eat'.
- If you are struggling complete the supplementary material and bring your answers to the next class to discuss with us.