Question 1: Which is bigger, protein or the mRNA coding for it?

size of typical bacterial protein = 300 a.a.

= 1000 bp

= 300 a.a. · 3 bp/a.a.

$m_{aa} = 100$ Da

$m_{nucleotide} = 300$ Da

$$\frac{m_{RNA}}{m_{Prot}} = \frac{1000 \text{ bases} \cdot 300 \text{ Da/base}}{300 \text{ a.a.} \cdot 100 \text{ Da/base}}$$

= 10 - fold

Question 2: Who is more powerful on a per kg basis, Hernan or the Sun? By what factor?

Hernan's power

Calories per day = 2000 kcal

1 kcal = 4184 J

$$\text{Power}_{human} = \frac{\text{Energy}}{\text{time}} = \frac{2000 \text{ kcal}}{1 \text{ day}}$$

$$= \frac{2000 \text{ kcal} \cdot 4184 \text{ J/kcal}}{1 \text{ day} \cdot 24 \frac{\text{hours}}{\text{day}} \cdot 60 \frac{\text{min}}{\text{hour}} \cdot 60 \frac{\text{s}}{\text{min}}}$$

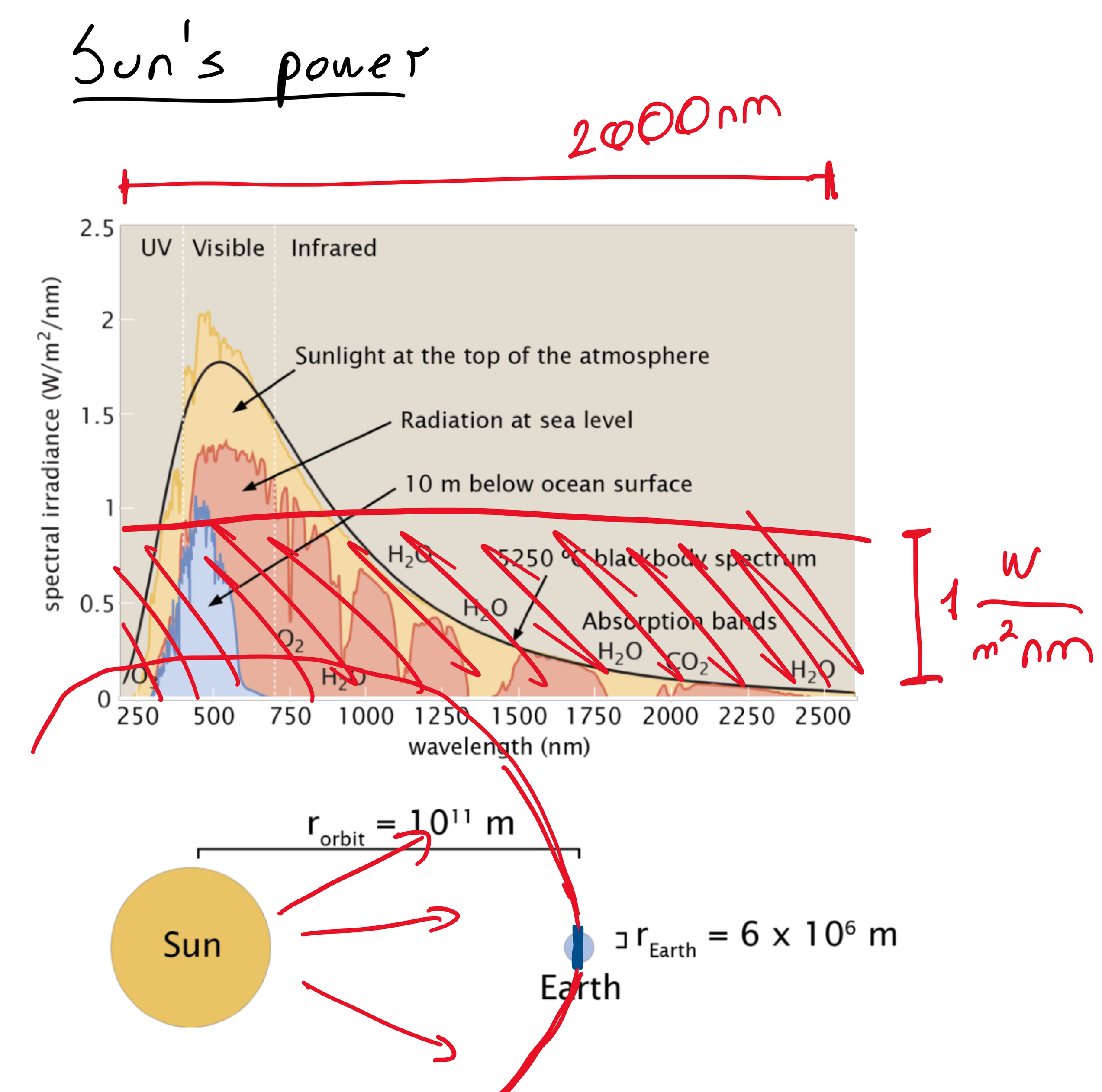
$$= \frac{2 \cdot 10^3 \cdot 4 \cdot 10^3 \text{ J}}{24 \cdot 3600 \text{ s}}$$

$$= \frac{8 \cdot 10^6 \text{ J}}{\text{few} \cdot 10 \cdot \text{few} \cdot 10^3 \text{ s}} \simeq \frac{10^7 \text{ J}}{10^5 \text{ s}}$$

= 100 W

$$\text{Power per mass}_{HG} = \frac{100 \text{ W}}{100 \text{ kg}} = 1 \text{ W/kg}$$

Sun's power



$$P_{sun}\Big|_{Earth} \simeq 1 \frac{\text{W}}{\text{m}^2 \text{ nm}} \cdot 2000 \text{ nm} =$$

$$= 2000 \frac{\text{W}}{\text{m}^2}$$

$$\frac{P_{sun@Earth}}{P_{sun}} = \frac{\text{Area}_{Earth}}{\text{Orbit area}}$$

$$\frac{P_{sun@Earth}}{\text{Area}_{Earth}} \cdot \text{Orbit Area} = P_{sun}$$

$$P_{sun} = 2000 \text{ W/m}^2 \cdot 4\pi \, (10^{11} \text{ m})^2$$

$$= 2 \cdot 10^3 \text{ W/m}^2 \cdot 4\pi \cdot 10^{22} \text{ m}^2$$

$$= 24 \cdot 10^{25} \text{ W}$$

$$\frac{P_{sun}}{m_{sun}} = \frac{24 \cdot 10^{25} \text{ W}}{2 \cdot 10^{30} \text{ kg}} = 12 \cdot 10^{-5} \text{ W/kg}$$

$$= 10^{-4} \text{ W/kg}$$

Question 4: The genome of *Vibrio cholera* is 4.03 Mbp. How many genes does it contain?

$\langle L_{protein} \rangle \simeq 300$ a.a.

⇓

$\langle L_{gene} \rangle \simeq 1000$ a.a.

Note to class: there was a typo in the calculation I did in class

$$\frac{L_{genome}}{L_{gene}} = N_{genes} = \frac{4 \cdot 10^6 \text{ bp}}{1000 \text{ bp}}$$

$$\simeq \frac{10^6}{10^3} \simeq 4 \cdot 10^3$$

Question 5: The human genome is 3 Gbp. How many genes does it contain?

Question 6: What length book would DNA polymerase (including proofreading) copy without an error? Human!

Question 7: Where is the most biomass harbored?