Presentación

Leyes de escala:

Ejercicios 3 y 4

Métodos de la física

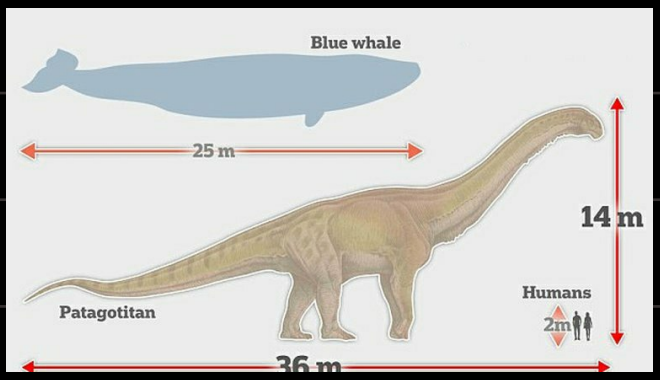
Magnitudes Físicas

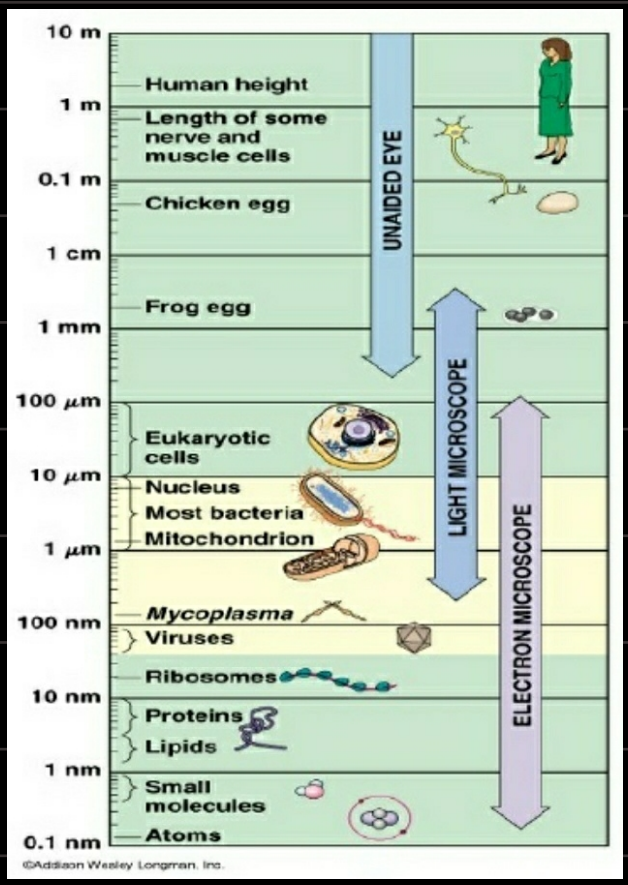
mediciones

Errores

Cifras significativas

Leyes de escala





En el mundo observamos una gran variedad de tamaños y formas: desde el patagotitán, que pesaba 69 10^3 kg y mide 36 m de largo y 14 m de alto, o la gran ballena azul, que pesa 2 10^5 kg y mide 30 m de largo, hasta el micoplasma , cuya masa es del orden dė $2 \cdot 10^{16}$ kg....

$$A \propto B^n$$

Para comparar los fenómenos que ocurren a diferentes escalas, utilizamos el análisis dimensional y las leyes de escala. Las leyes de escala son, matemáticamente hablado, leyes de potencias que interrelacionan dos variables que describen un proceso natural.

En Biología se las conoce con el nombre leyes alométricas. Dichas leyes nos hablan del diferente crecimiento relativo de las dos variables de interés, en contraposición con las leyes isométricas, que serían aquellas en las que el exponente vale 1 y una variable crece proporcionalmente respecto a la otra.

$$\text{dosis [cc]} \propto L^{a}$$; a: exponente alométrico

(∝: proporcional)

$d_3 \rightarrow 3$

$d_5 = ? \rightarrow 5$

$d_5 = \frac{5}{3} d_3$

No existen leyes de escala generales y, para llegar a una, primero hay que establecer una hipótesis biológica que intente describir el proceso subyacente. En algunos casos se puede utilizar el Principio de Semejanza, establecido por Arquímedes para figuras geométricamente semejantes (isometría), apoyándonos en alguna hipótesis biológica. Pero este principio presenta ciertas limitaciones, y Galileo se dio cuenta de ellas 2000 años después....

$\rho_3 = \rho_5$

Tusko

$m_3 = \rho_3 V_3$

$m_5 = \rho_3 V_5$

Una mujer de 1,55 m de altura pesa 50 kg.
¿Cuánto pesaría una mujer de 1,70 m y forma semejante?

$$\boxed{m = \rho V =}$$

$V = b \cdot h \cdot a$

$V_1 = b_1 h_1 a_1 \; ; \; V_2 = b_2 h_2 a_2$

$h_1 = 1{,}55\ m$

$h_2 = 1{,}70\ m$

$b_1 \text{ — } h_1$

$b_2 \text{ — } h_2$

$a_1 \text{ — } h_1$

$a_2 \text{ — } h_2$

$$\boxed{L = \frac{h_2}{h_1} = \frac{1{,}70\ \cancel{m}}{1{,}55\ \cancel{m}} = 1{,}10}$$

$$b_2 = \frac{h_2}{h_1} b_1 = L b_1$$

$$a_2 = \frac{h_2}{h_1} a_1 = L a_1$$

$$V_2 = (L a_1)(L b_1)(L h_1) = L^3 a_1 b_1 h_1$$

(a_2, b_2, h_2)

$L^a \cdot L^b = L^{a+b}$

$a \cdot b = b \cdot a$

$$V_2 = L^3 V_1$$

$$m_2 = \rho V_2 = \rho L^3 V_1 = L^3 \rho V_1 = L^3 m_1$$

$m_2 = (1{,}1)^3 \cdot 50 = 67\ kg$

¿Cuál es la proporción entre los pesos máximos que pueden levantar una persona de 130 cm de altura y una de 1,65m de altura respectivamente? Suponer forma y estructura semejante.

$$A = \pi r^2$$

$$F_1 \propto A$$

$$A_2 = \pi r_2^2$$

$$r_2^2 = (L r_1)^2$$

$$A_2 = \pi (L^2 r_1^2)$$

$$A_2 = L^2 A_1$$

$$L = \frac{h_2}{h_1} = 1{,}27$$

$$F_2 = L^2 F_1 = 1{,}61 \times F_1$$

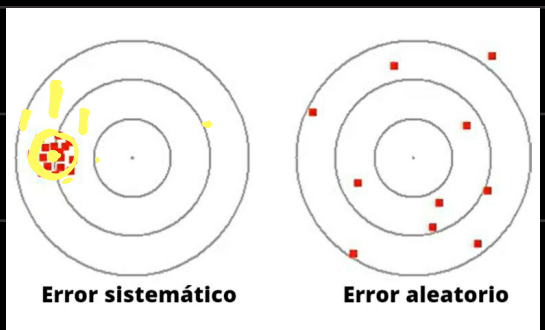
Métodos de la Física

* Objetividad
  → Traducible sistemáticamente

* Repetibilidad

* Medición
  * Aparatos
    * Indep. de emociones
    * Factores subjetivos

* Aproximaciones y errores
  - precisión del instrumento
  - Errores aleatórios
  - Errores sistemáticos



A ROUGH GUIDE TO SPOTTING

BAD SCIENCE

Ben Goldacre

1. SENSATIONALISED HEADLINES

Headlines of articles are commonly designed to entice viewers into clicking on and reading the article. At best, they over-simplify the findings of research. At worst, they sensationalise and mis-represent them.

2. MISINTERPRETED RESULTS

News articles sometimes distort or misinterpret the findings of research for the sake of a good story, intentionally or otherwise. If possible, try to read the original research, rather than relying on the article based on it for information.

3. CONFLICT OF INTERESTS

Many companies employ scientists to carry out and publish research - whilst this does not necessarily invalidate research, it should be analysed with this in mind. Research can also be misrepresented for personal or financial gain.

4. CORRELATION & CAUSATION

Be wary of confusion of correlation & causation. Correlation between two variables doesn't automatically mean one causes the other. Global warming has increased since the 1800s, and pirate numbers decreased, but lack of pirates doesn't cause global warming.

5. SPECULATIVE LANGUAGE

Speculations from research are just that - speculation. Be on the look out for words such as 'may', 'could', 'might', and others, as it is unlikely the research provides hard evidence for any conclusions they precede.

6. SAMPLE SIZE TOO SMALL

In trials, the smaller a sample size, the lower the confidence in the results from that sample. Conclusions drawn should be considered with this in mind, though in some cases small samples are unavoidable. It may be cause for suspicion if a large sample was possible but avoided.

7. UNREPRESENTATIVE SAMPLES

In human trials, researchers will try to select individuals that are representative of a larger population. If the sample is different from the population as a whole, then the conclusions may well also be different.

8. NO CONTROL GROUP USED

In clinical trials, results from test subjects should be compared to a 'control group' not given the substance being tested. Groups should also be allocated randomly. In general experiments, a control test should be used where all variables are controlled.

9. NO BLIND TESTING USED

To prevent any bias, subjects should not know if they are in the test or the control group. In double-blind testing, even researchers don't know which group subjects are in until after testing. Note, blind testing isn't always feasible, or ethical.

10. 'CHERRY-PICKED' RESULTS

This involves selecting data from experiments which supports the conclusion of the research, whilst ignoring those that do not. If a research paper draws conclusions from a selection of its results, not all, it may be cherry-picking.

11. UNREPLICABLE RESULTS

Results should be replicable by independent research, and tested over a wide range of conditions (where possible) to ensure they are generalisable. Extraordinary claims require extraordinary evidence - that is, much more than one independent study!

12. JOURNALS & CITATIONS

Research published to major journals will have undergone a review process, but can still be flawed, so should still be evaluated with these points in mind. Similarly, large numbers of citations do not always indicate that research is highly regarded.

$10^6 = 1000000$

Magnitudes físicas

$R_T = 6,7 \times 10^6 m$ $d = 12,3 cm$

Posición / distancia

Longitud $L = [\vec{r}] = [l] = [d]$

$[A] = L^2$ $[V] = L^3$

tiempo intervalo

$T = [t] = [\Delta t]$

Masa $M = [m]$

□ Fuerza $[F] = M^1 \cdot L^1 \cdot T^{-2}$

$E = 10,3$ Joules $[E] = M^1 \cdot L^2 \cdot T^{-2}$

Las dimensiones son tratadas como números: se mult... dividen...

$L \cdot L = L^2$ $m \cdot m = m^2$

si $A = B \Rightarrow [A] = [B]$

si $C = A + B \Rightarrow [A] = [B]$

$[13] = 1 = M^0 \cdot L^0 \cdot T^0$

$[13\,m] = L$

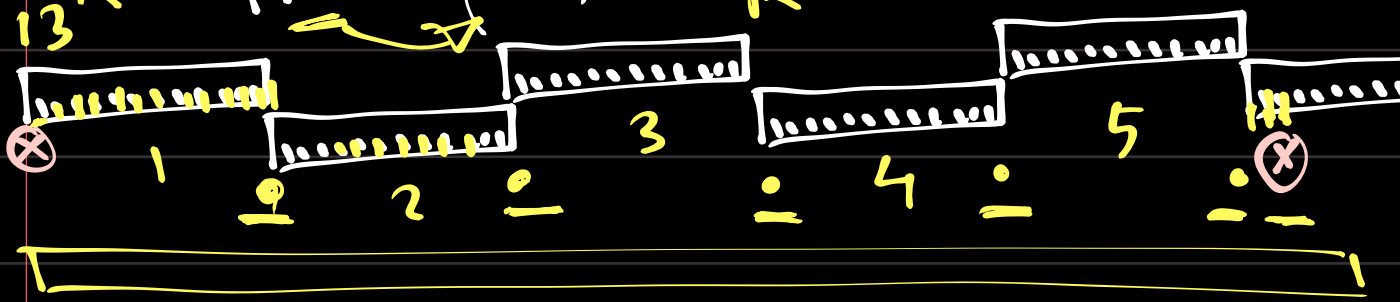
Unidades $\neq$ dimensiones

Unidades ~ sistemas de medición

(Aparato específico)

$d = 5R + 2U = (5 \cdot 13 + 2)U = \left(5 + \frac{2}{13}\right)R$

$U = \frac{1}{13}R \qquad 1R = 13 \cdot (U) \qquad \frac{13U}{R} = 1$



$Error = U + U + U + U + U + U$

$= 6U$

→ metros / Pies

$1\,m = 100\,cm = 3{,}28\ pies \Rightarrow \boxed{1 = 3{,}28\ \frac{pies}{m}}$

$3{,}7\,m \times \left(3{,}28\ \frac{pies}{m}\right)$

→ Litros / Galones

$\boxed{1 = 3{,}79\ L/Gal}$

$\Rightarrow 20\ gal = 20\ gal \times 3{,}79\ \frac{L}{gal}$

$\sim 75{,}8\ L$