

Learning through research with OSH



Juan E. Keymer

Interdisciplinary Professor
Biology & Physics

Learning?

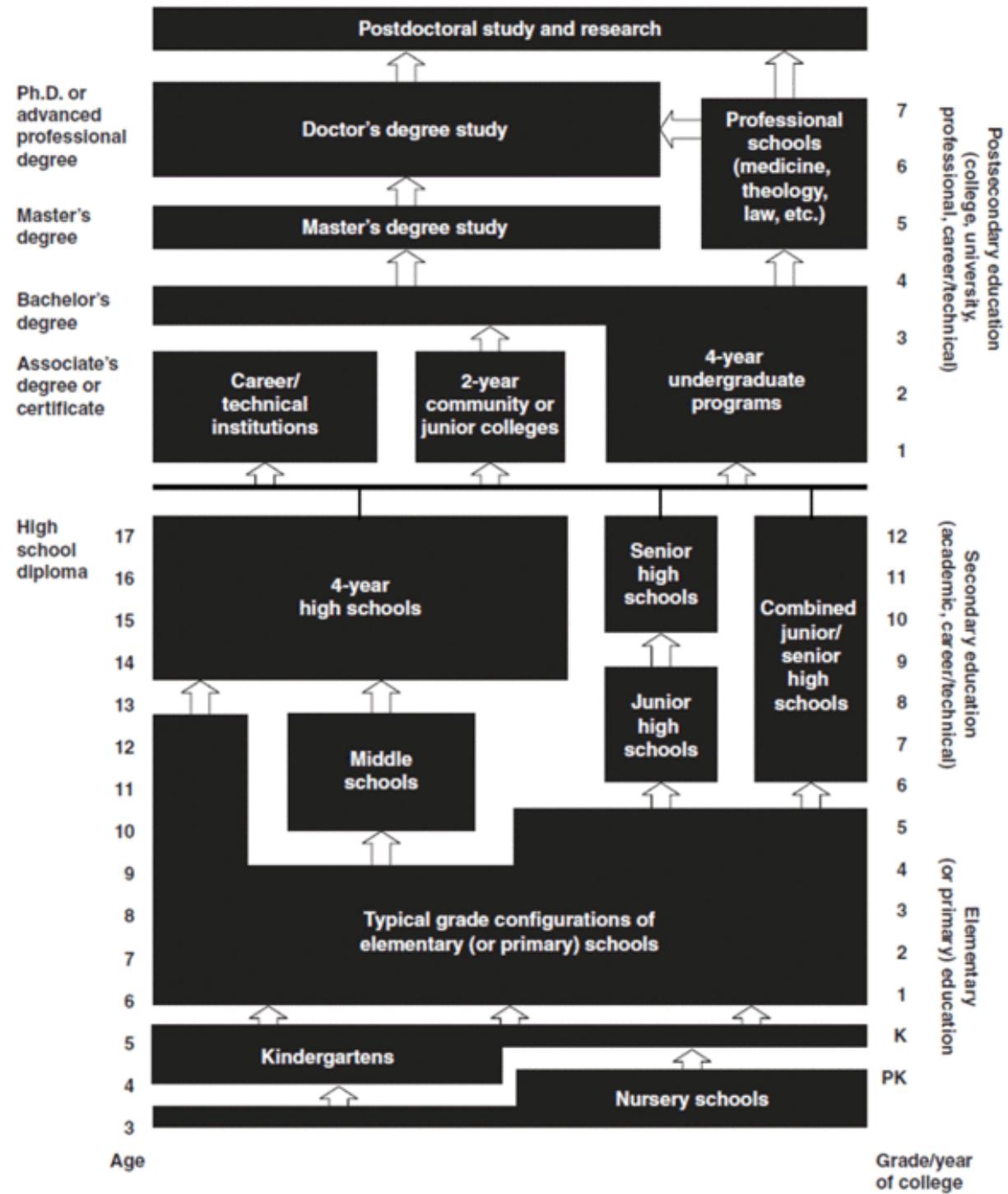


Open FIESTA



ORIC+

How & Why?



Why:

Science

Science 04 Nov 1960:
Vol. 132, Issue 3436, pp. 1291-1295
DOI: 10.1126/science.132.3436.1291

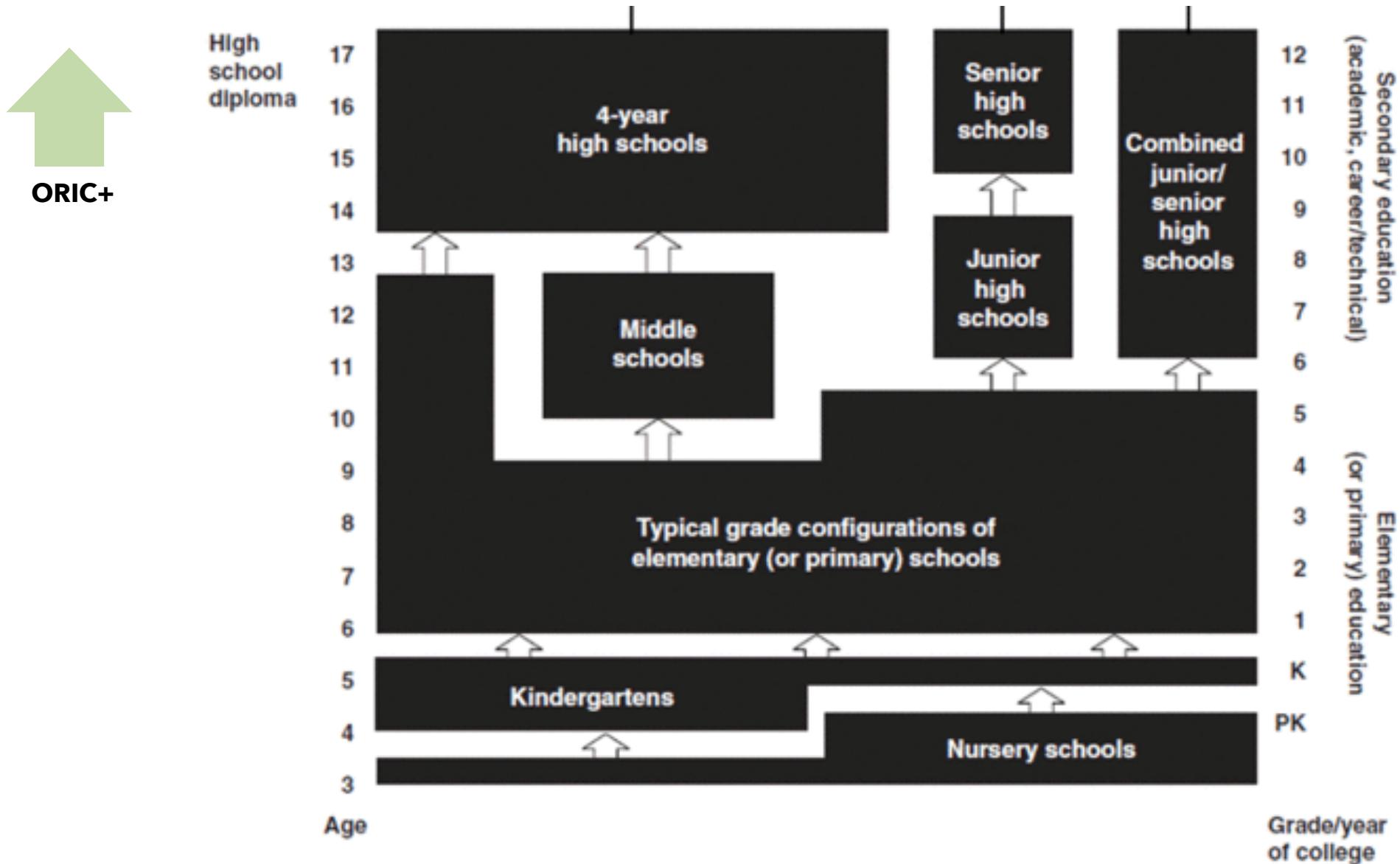
Doomsday: Friday, 13 November, A.D. 2026

By Heinz von Foerster, Patricia M. Mora, Lawrence W. Amiot

At this date human population will approach infinity
if it grows as it has grown in the last two millenia.

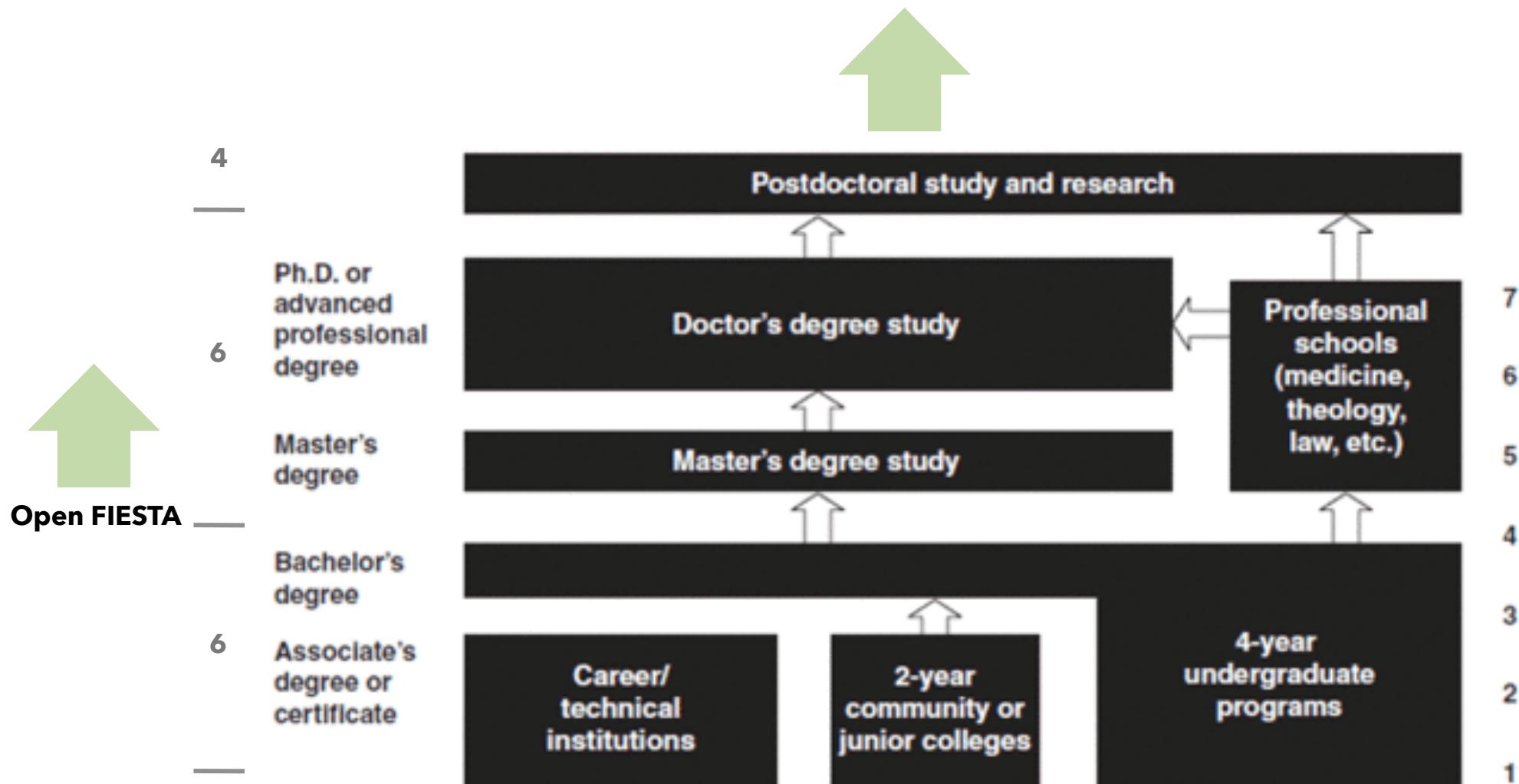


How: first we do 12 years of K12



... then we do $12 + 4$ more

34



18

Why:

Science

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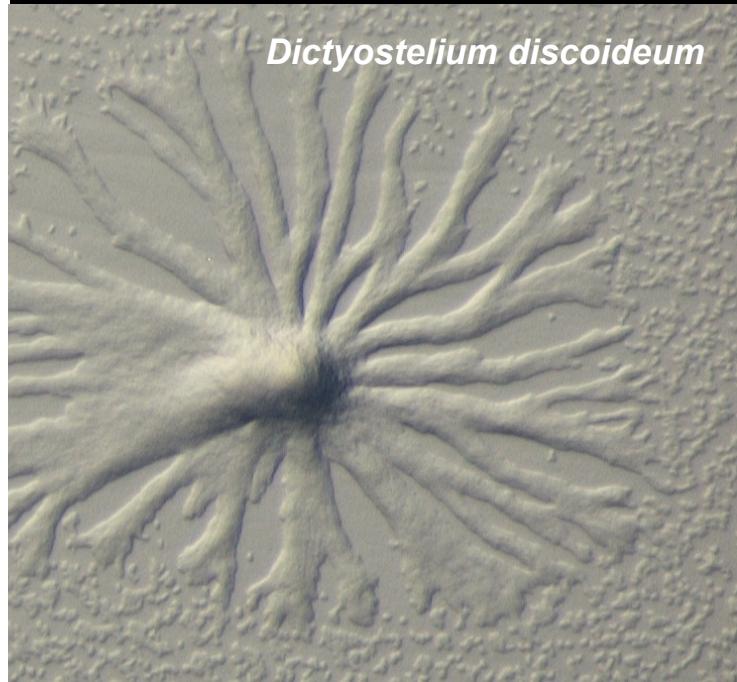
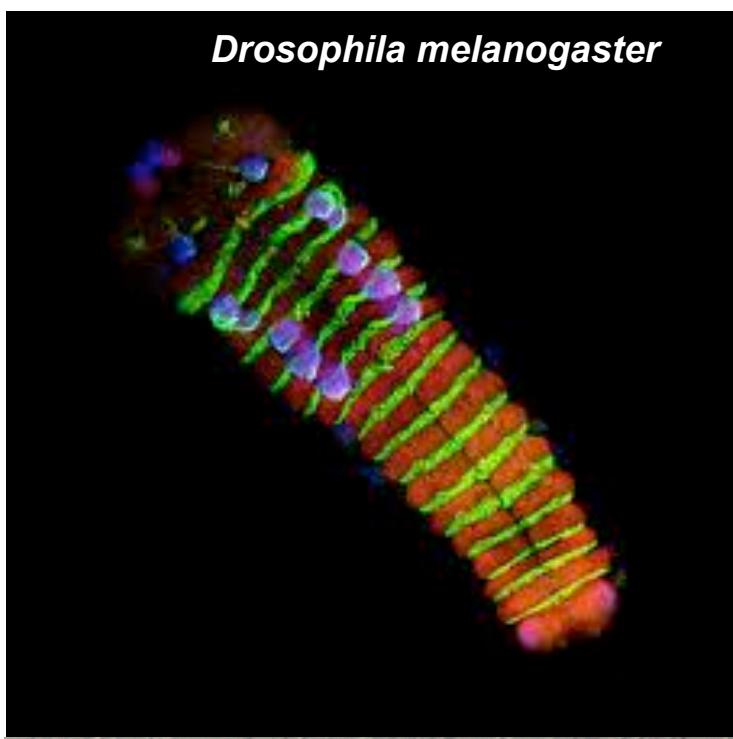
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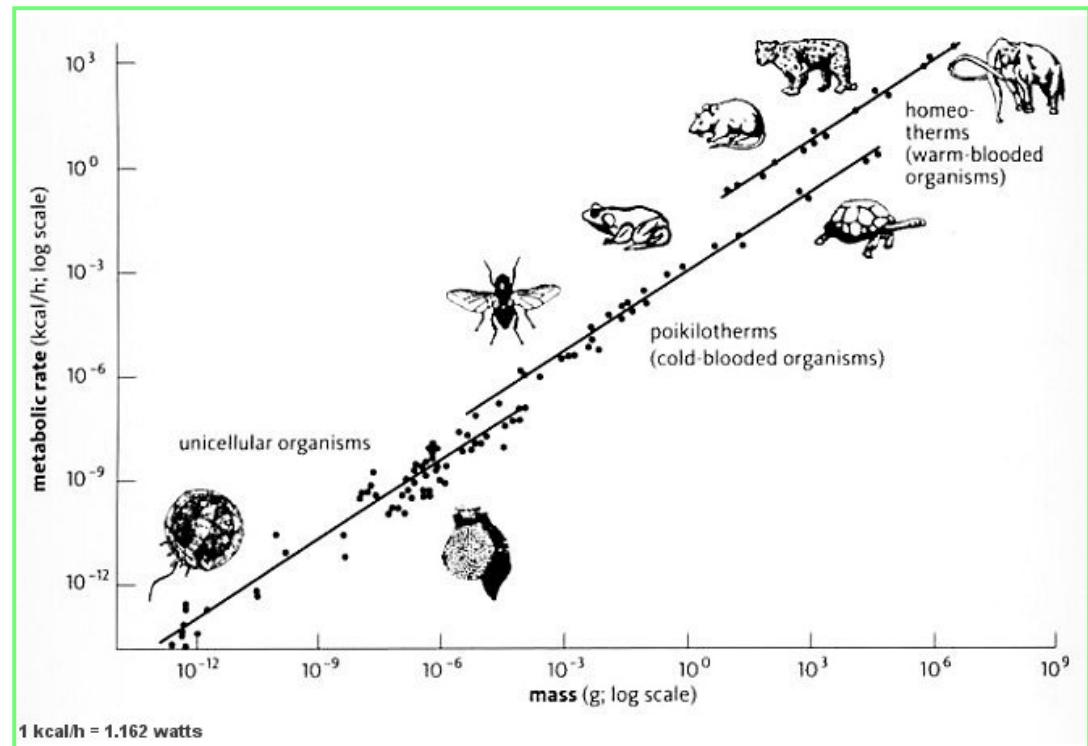


Drosophila melanogaster



allometric scaling laws

$$Y(t) = Y_0 N(t)^\beta$$

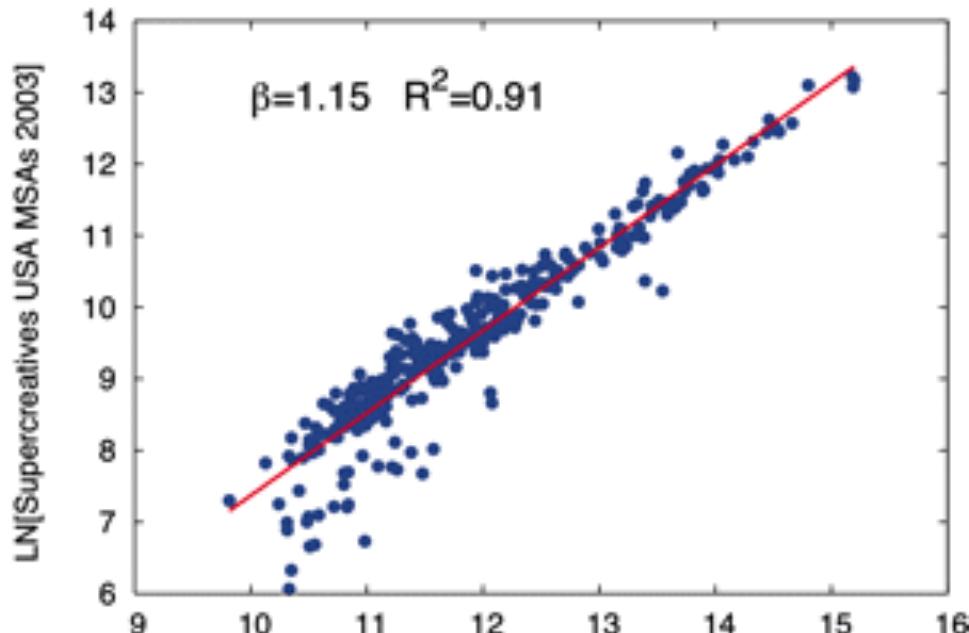
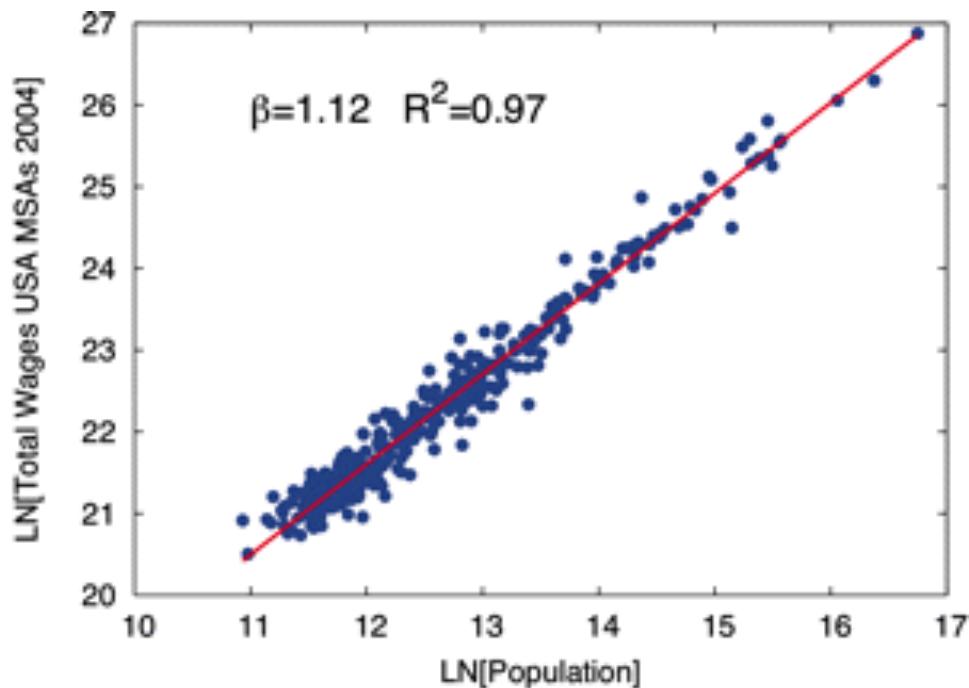


Growth, innovation, scaling, and the pace of life in cities

Luís M. A. Bettencourt, José Lobo, Dirk Helbing, Christian Kühnert, and Geoffrey B. West

PNAS April 24, 2007 104 (17) 7301-7306; <https://doi.org/10.1073/pnas.0610172104>

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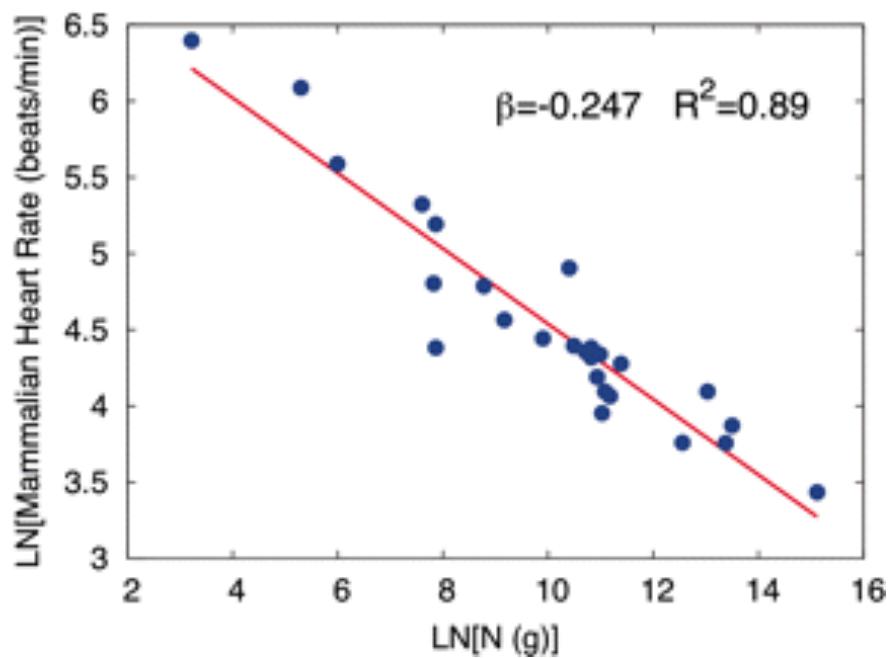
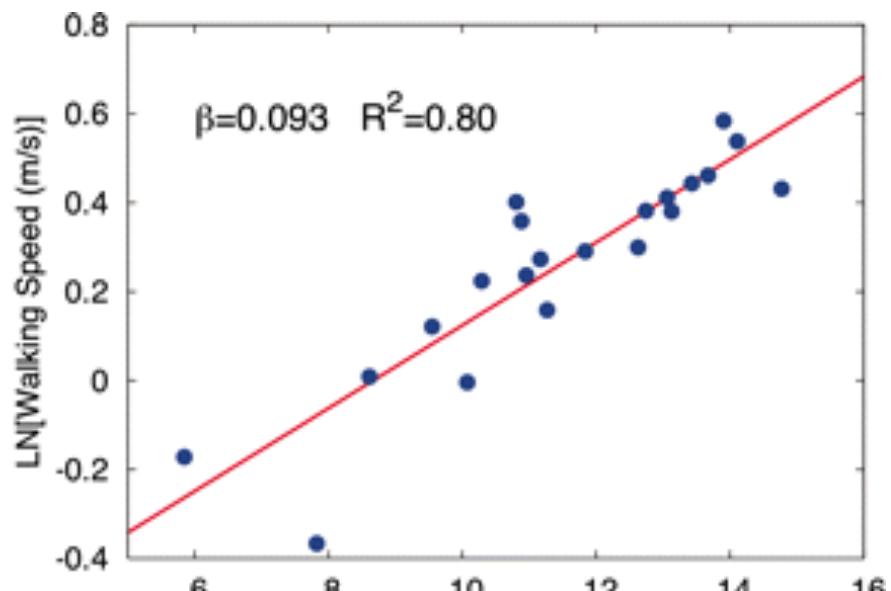


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$$Y(t) = Y_0 N(t)^\beta$$



Urban Growth Equation.

- Growth is constrained by the availability of resources and their rates of consumption.
- Resources, Y , are used for both maintenance and growth.

$$Y = RN + E \cdot \frac{dN}{dt}$$



$$\frac{dN(t)}{dt} = \frac{Y_0}{E} N(t)^\beta - \frac{R}{E} N(t)$$



$$N(t) = \left[\frac{Y_0}{E} + \left(N(0)^{1-\beta} - \frac{Y_0}{R} \right) \exp \left[-\frac{R}{E} (1-\beta)t \right] \right]^{\frac{1}{1-\beta}}$$

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Economies of scale

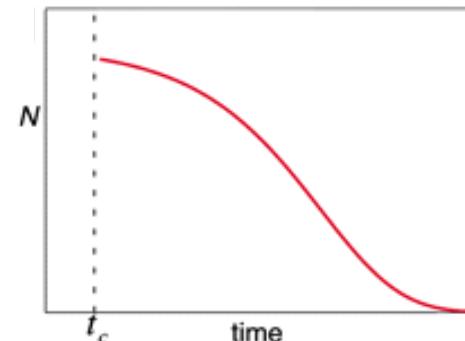
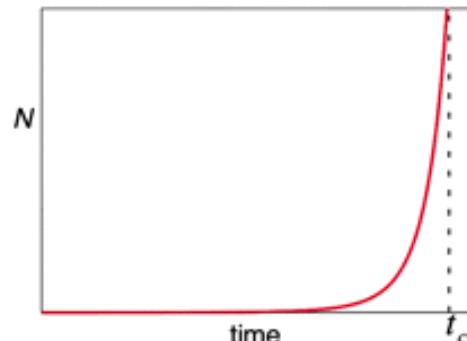
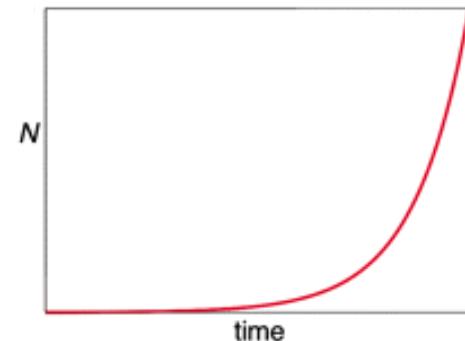
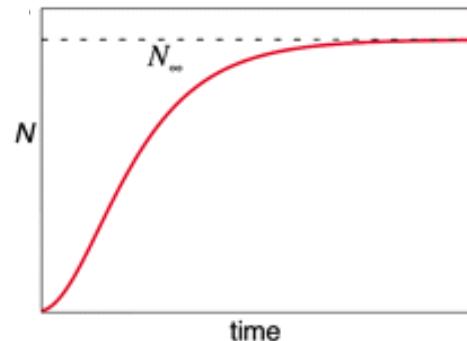
$$\beta < 1$$

Exponential growth

$$\beta = 1$$

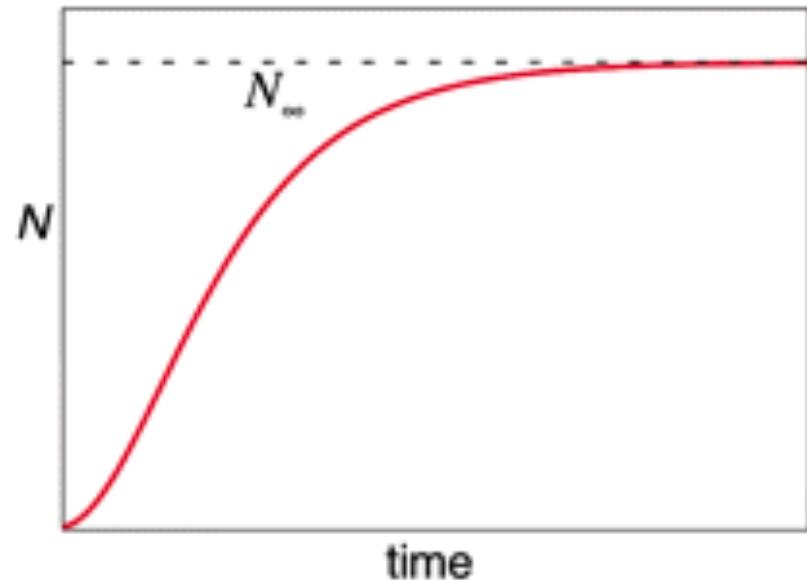
Increasing returns

$$\beta > 1$$



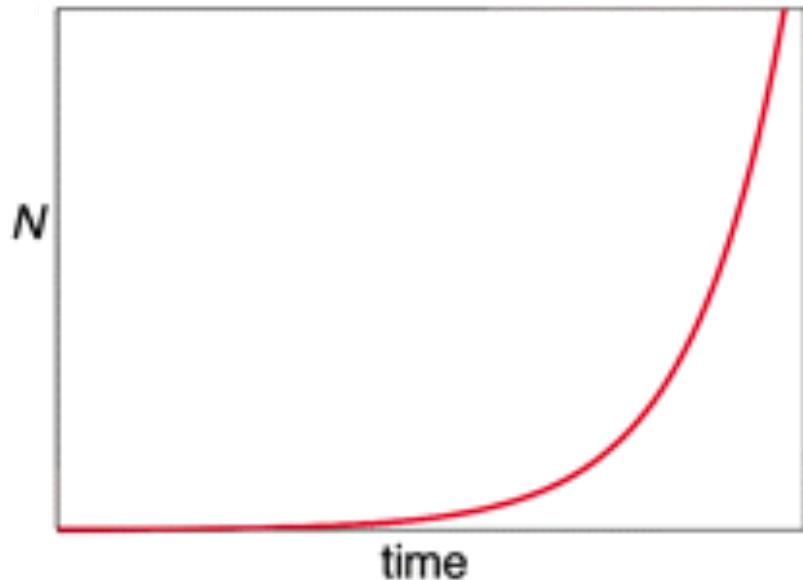
Economies of scale

$$\beta < 1$$



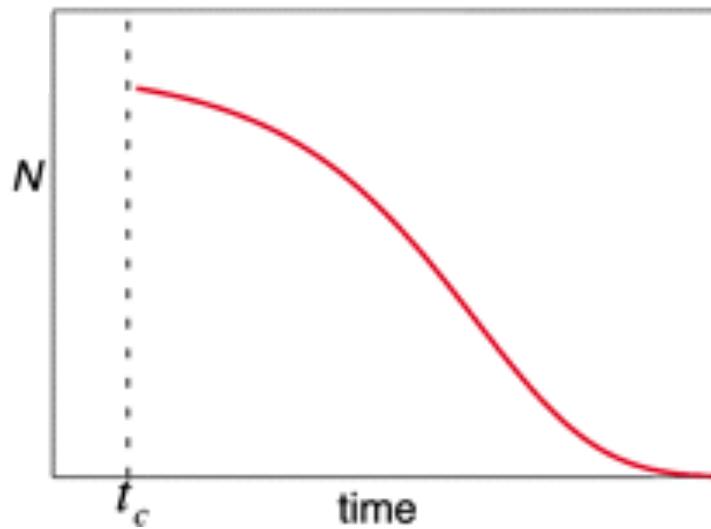
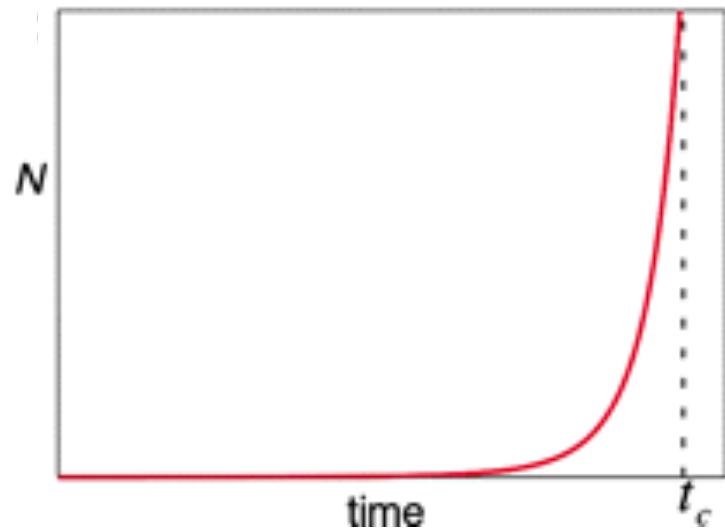
Exponential growth

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Increasing returns

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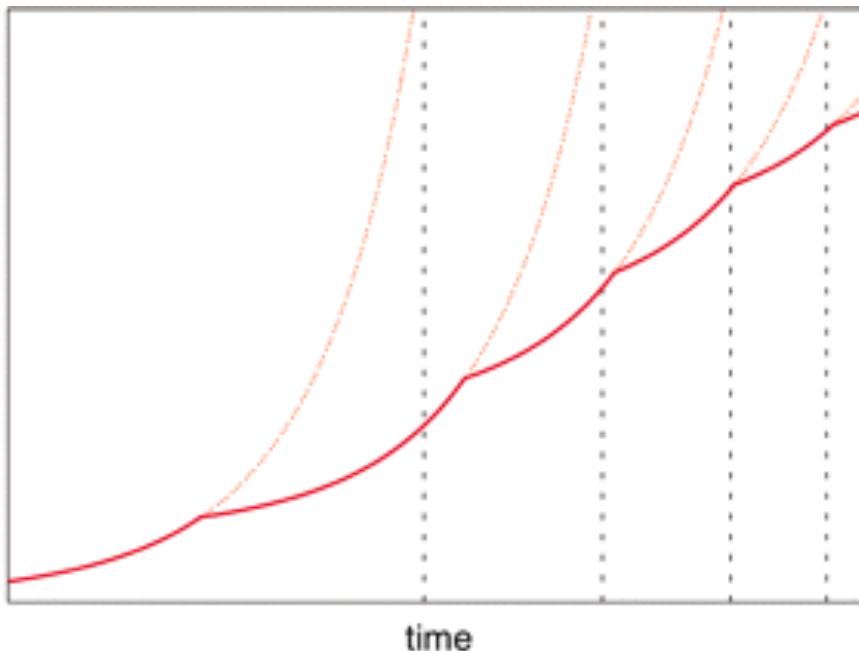


$$t_c = -\frac{E}{(\beta - 1)R} \ln \left[1 - \frac{R}{Y_0} N(0)^{1-\beta} \right]$$

$$N(0) < (R/Y_0)^{1/(1-\beta)}$$

$$N(0) > (R/Y_0)^{1/(1-\beta)}$$

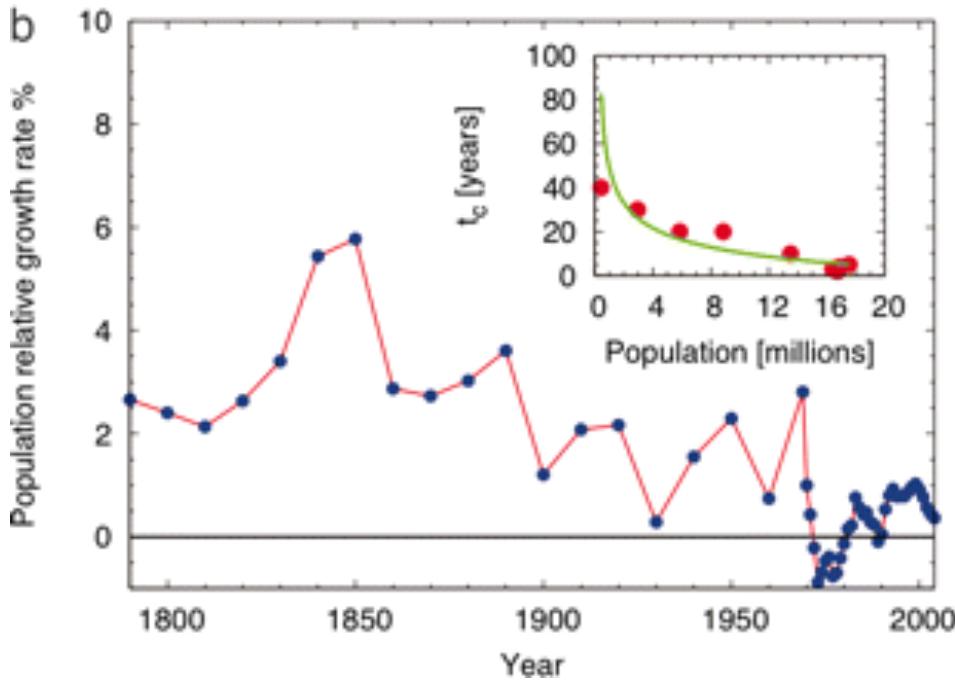
a

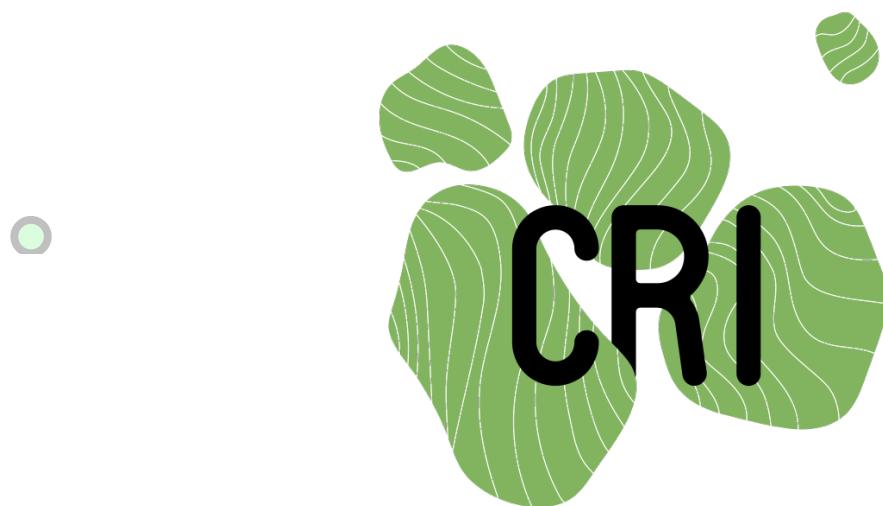


Increasing returns

$$\beta > 1$$

b





Paris, France



Shenzhen, China

Gathering for Open Science Hardware



Geneva, Santiago, Shezhen

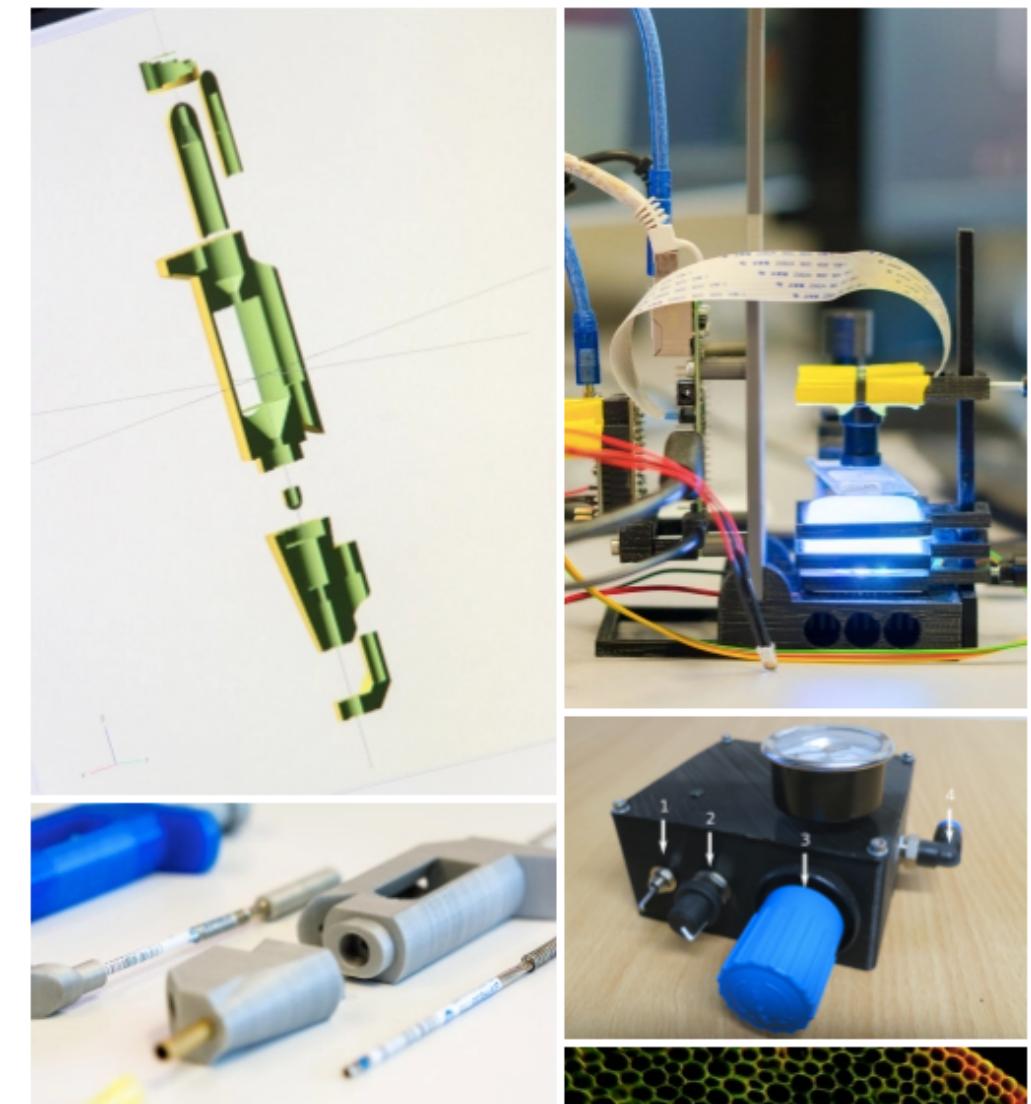
GOSH

OSH mainstream by 2025!





Teaching and Research in Natural Sciences
for Development in Africa





TECNO X 4.0

Brazil



Argentina (1.0), Mexico (2.0), Chile (3.0)



2018 “ORIC+”开放创新中学营在清华附中成功举办

ORIC+





OSH
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Learning through research with OSH



Students + Mentors

ORIC+