

Global Challenges

UOSM2010 2014

Peak Phosphorus

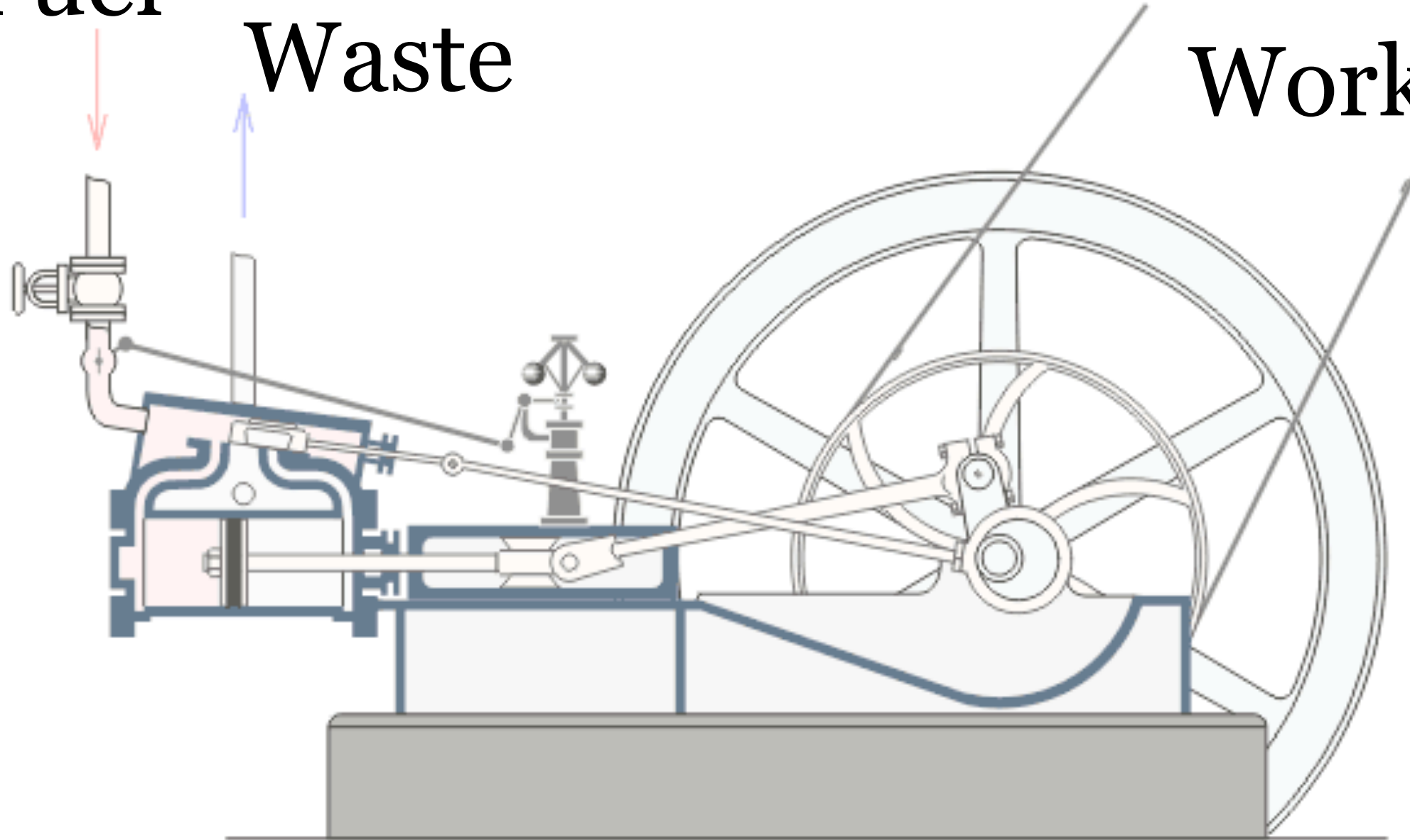
Module leader
James Dyke [jd4@ecs.soton](mailto:jd4@ecs.soton.ac.uk)

Module webpage
www.gc.soton.ac.uk

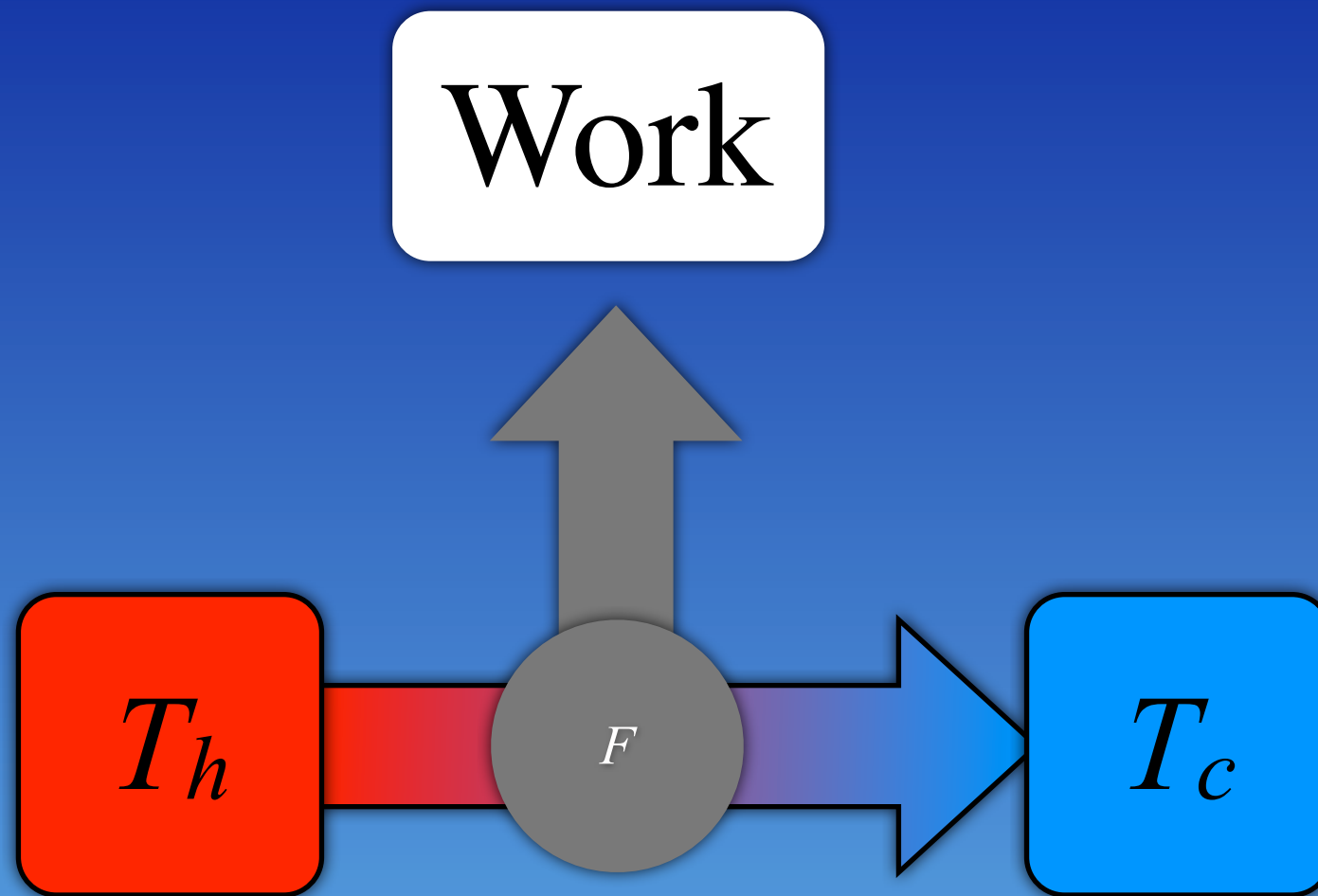
Fuel

Waste

Work



Global Challenges



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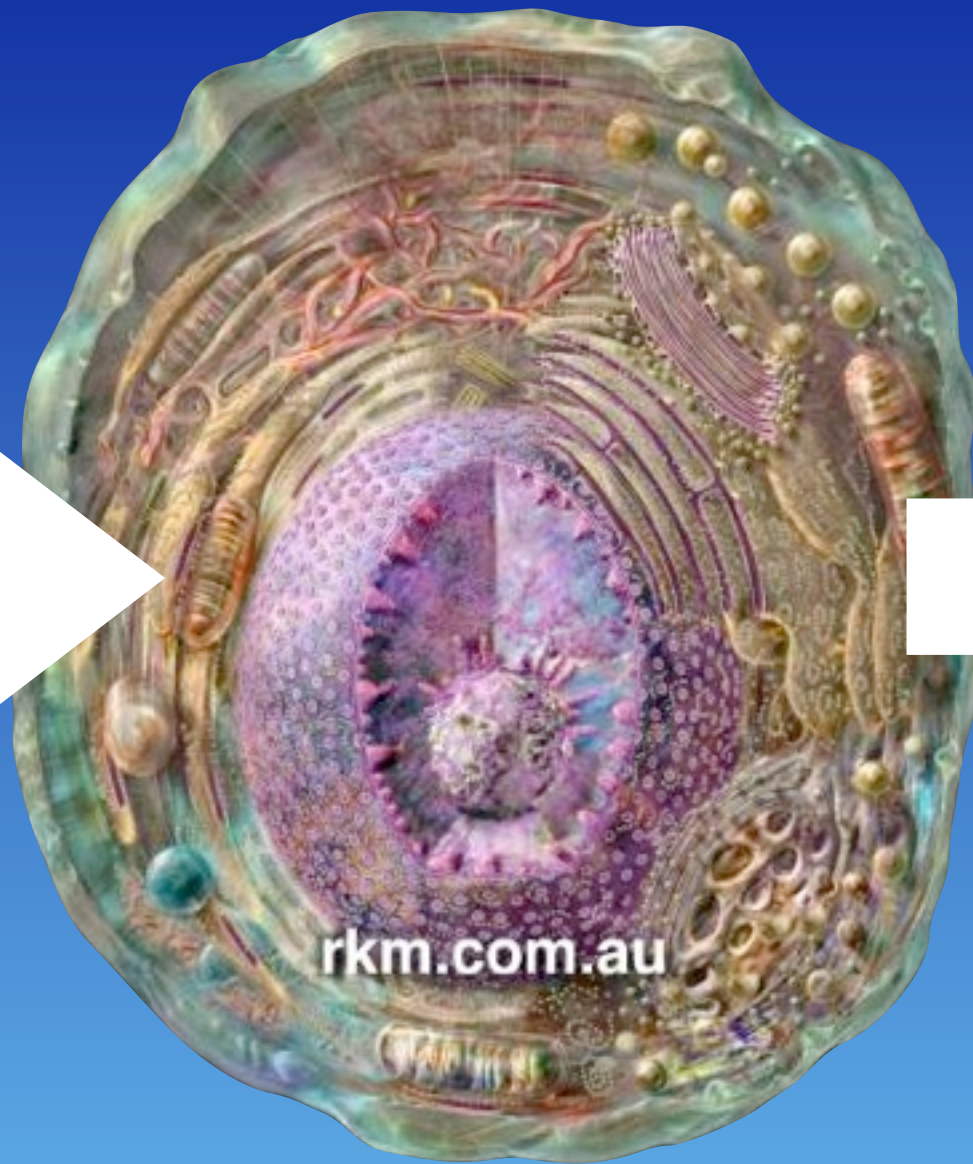
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Food



Global Challenges

Food



Waste

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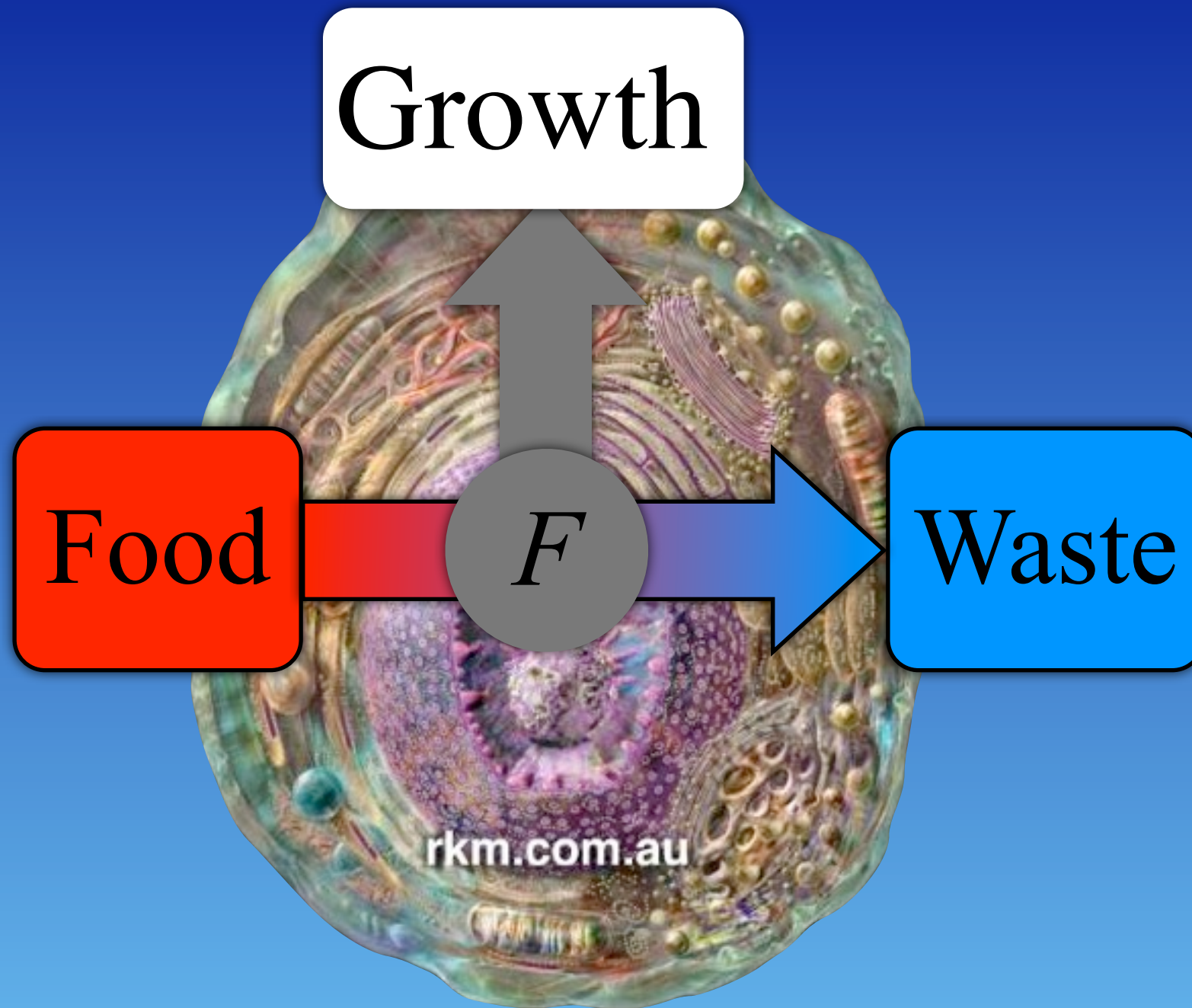
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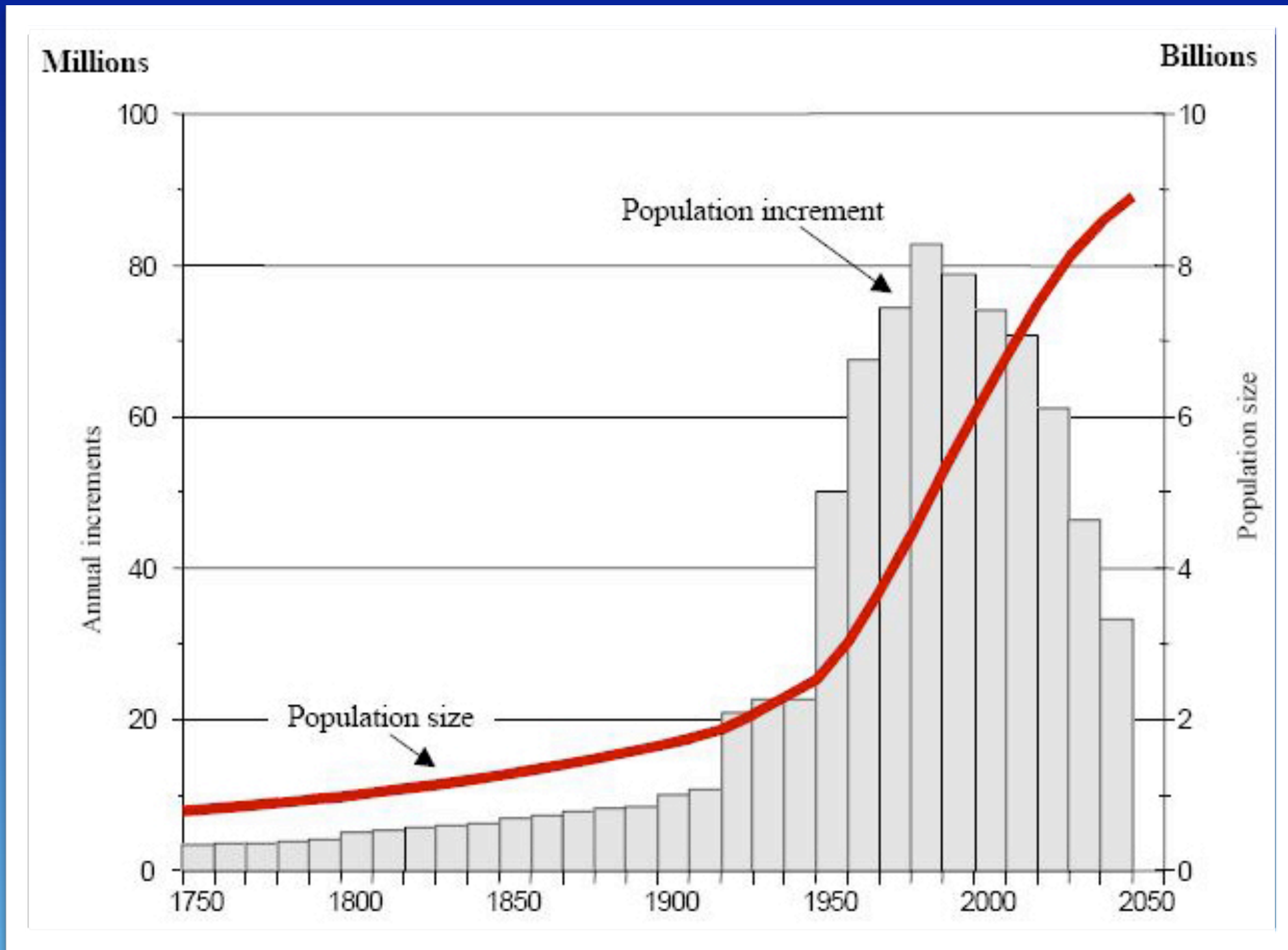
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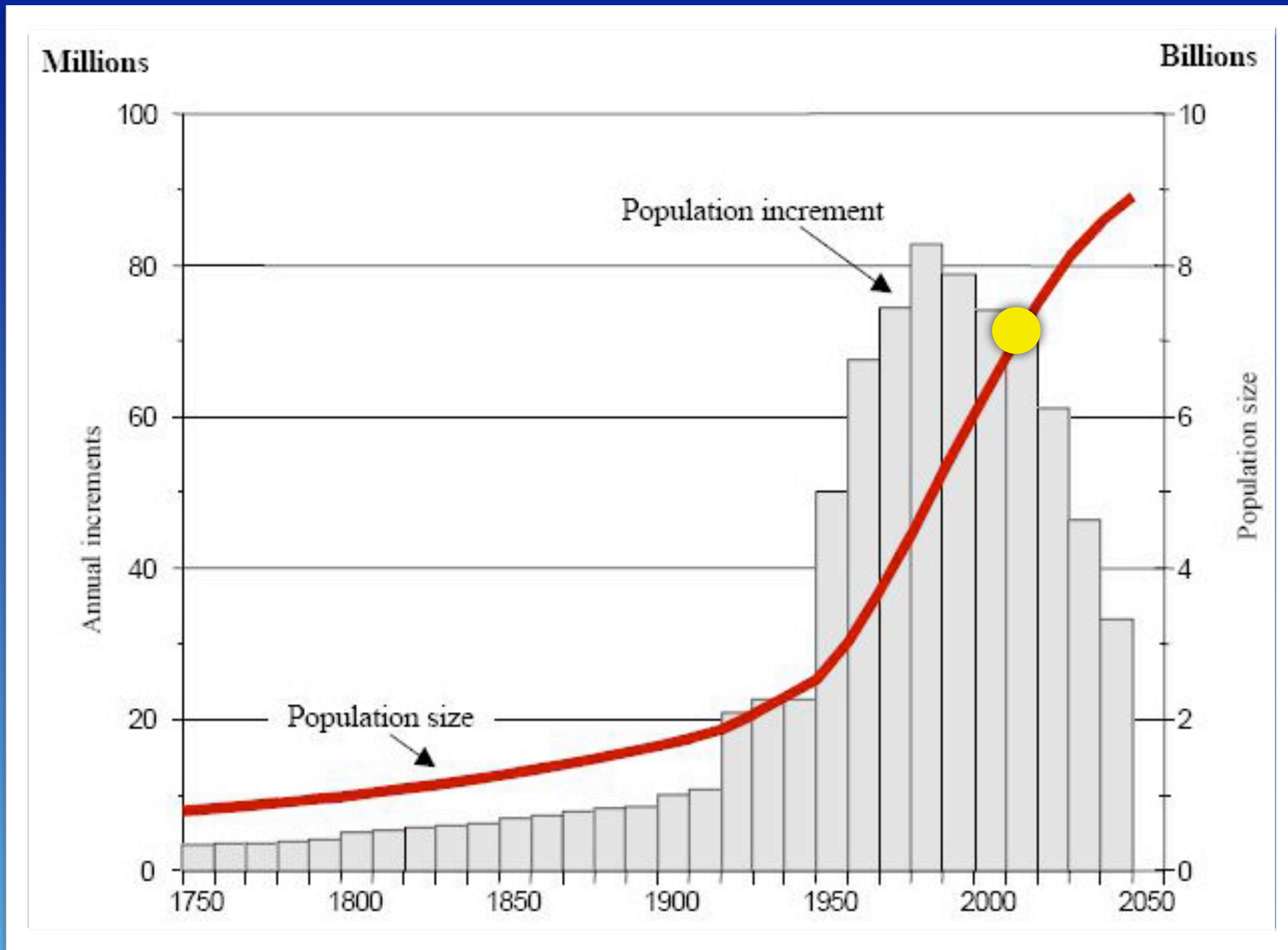
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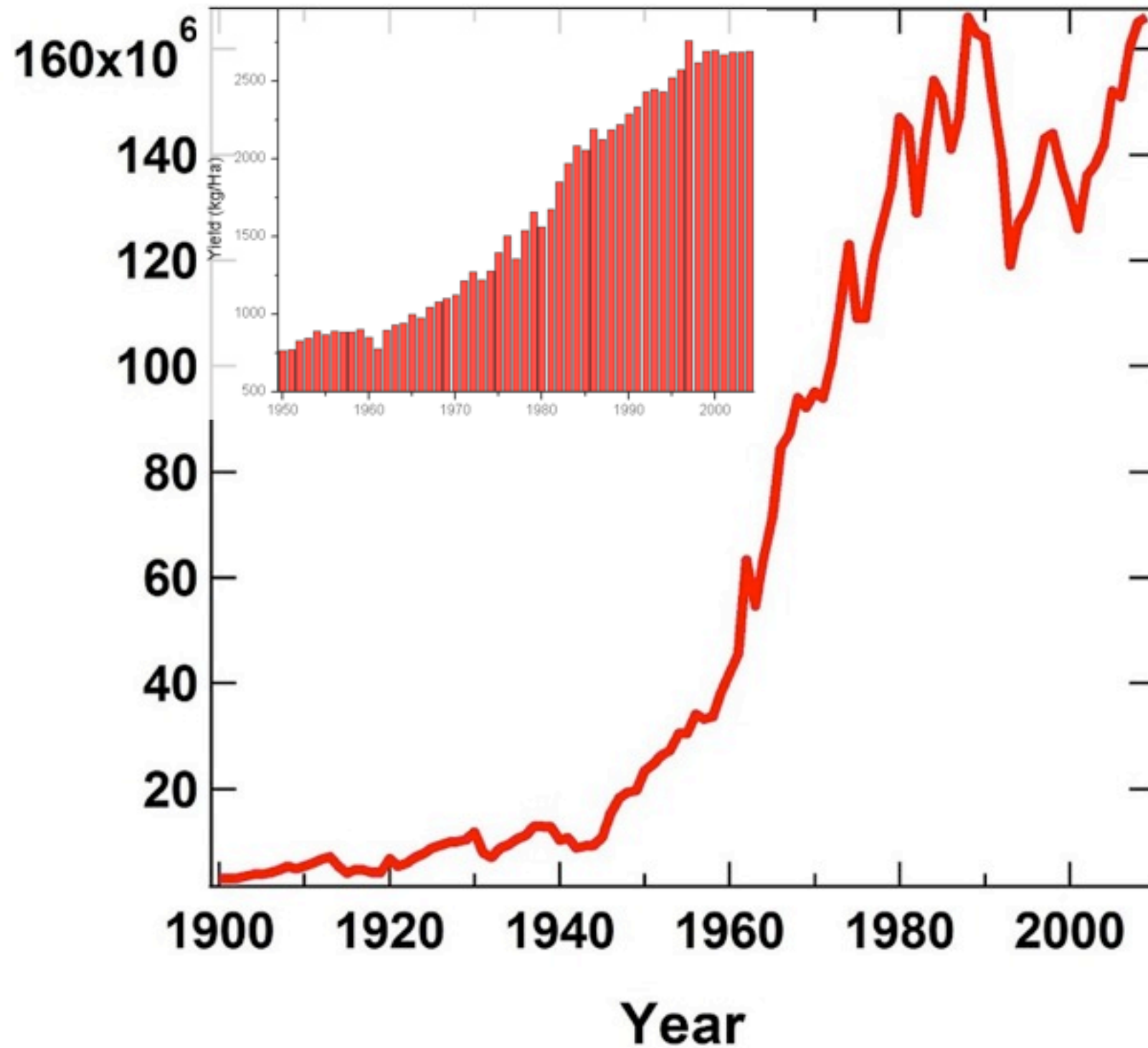


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World Phosphate Rock Production (metric tonne)



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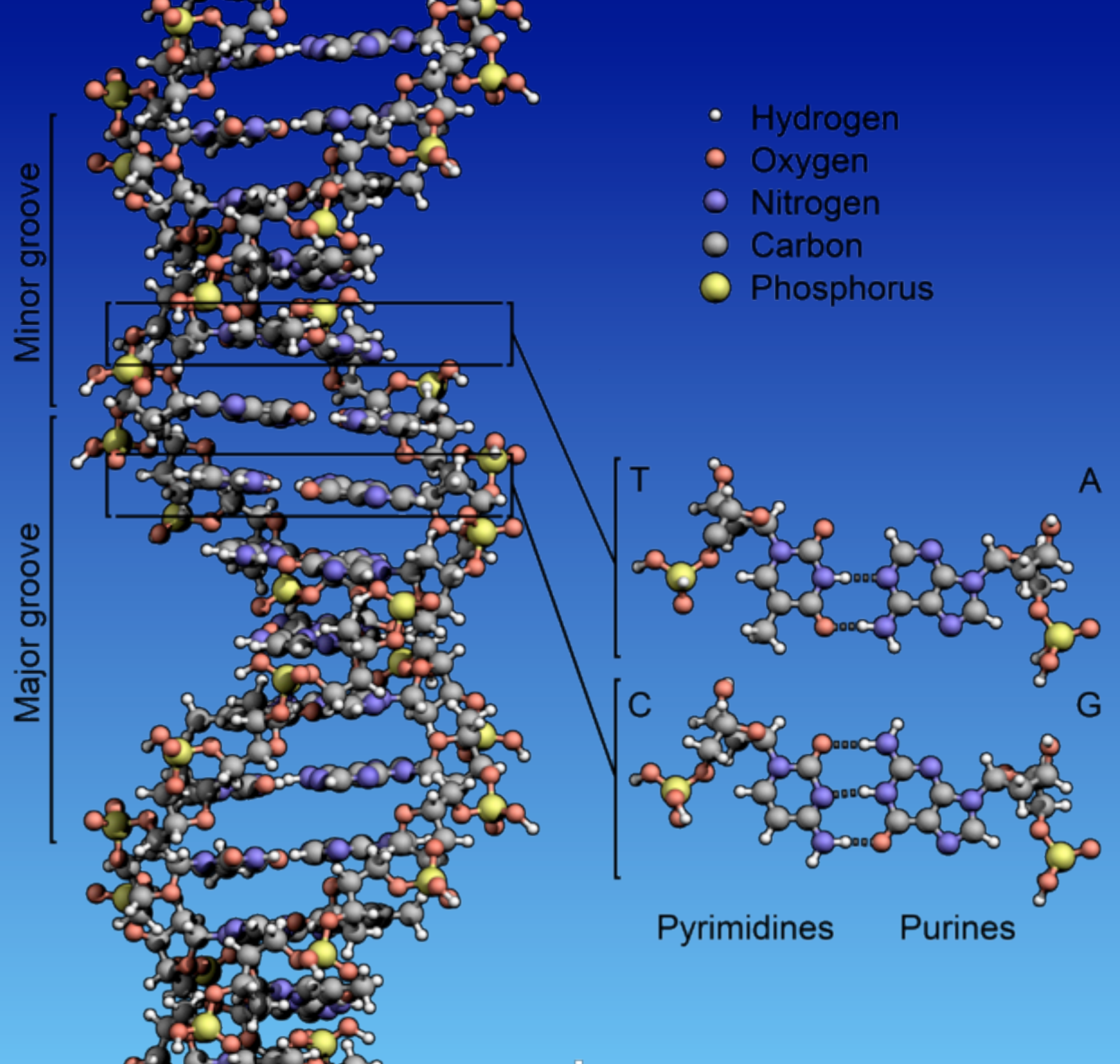
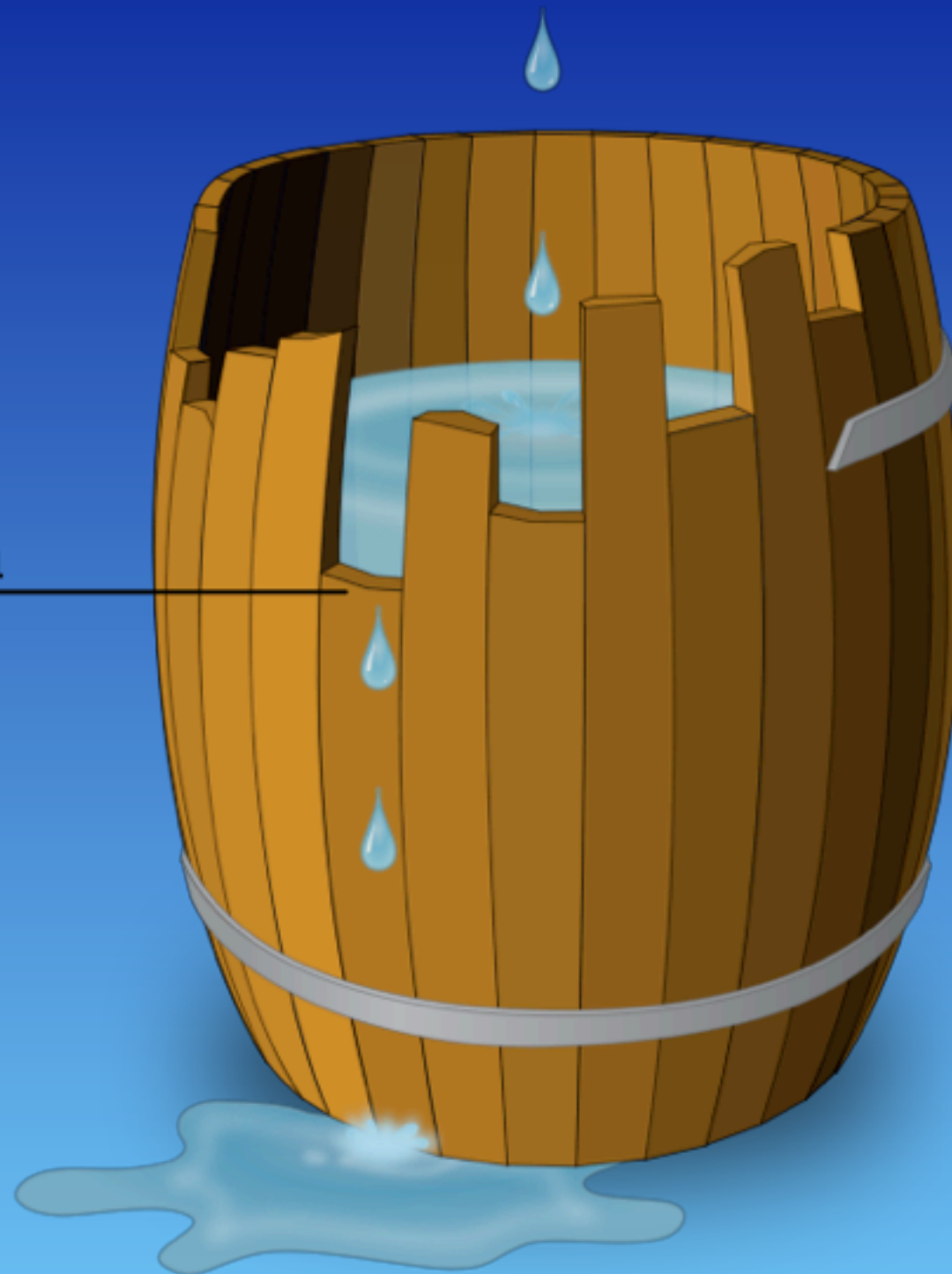


Image: Wikipedia

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Minimum



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Photos: Wikipedia, David Dennis Rabines Alarcon

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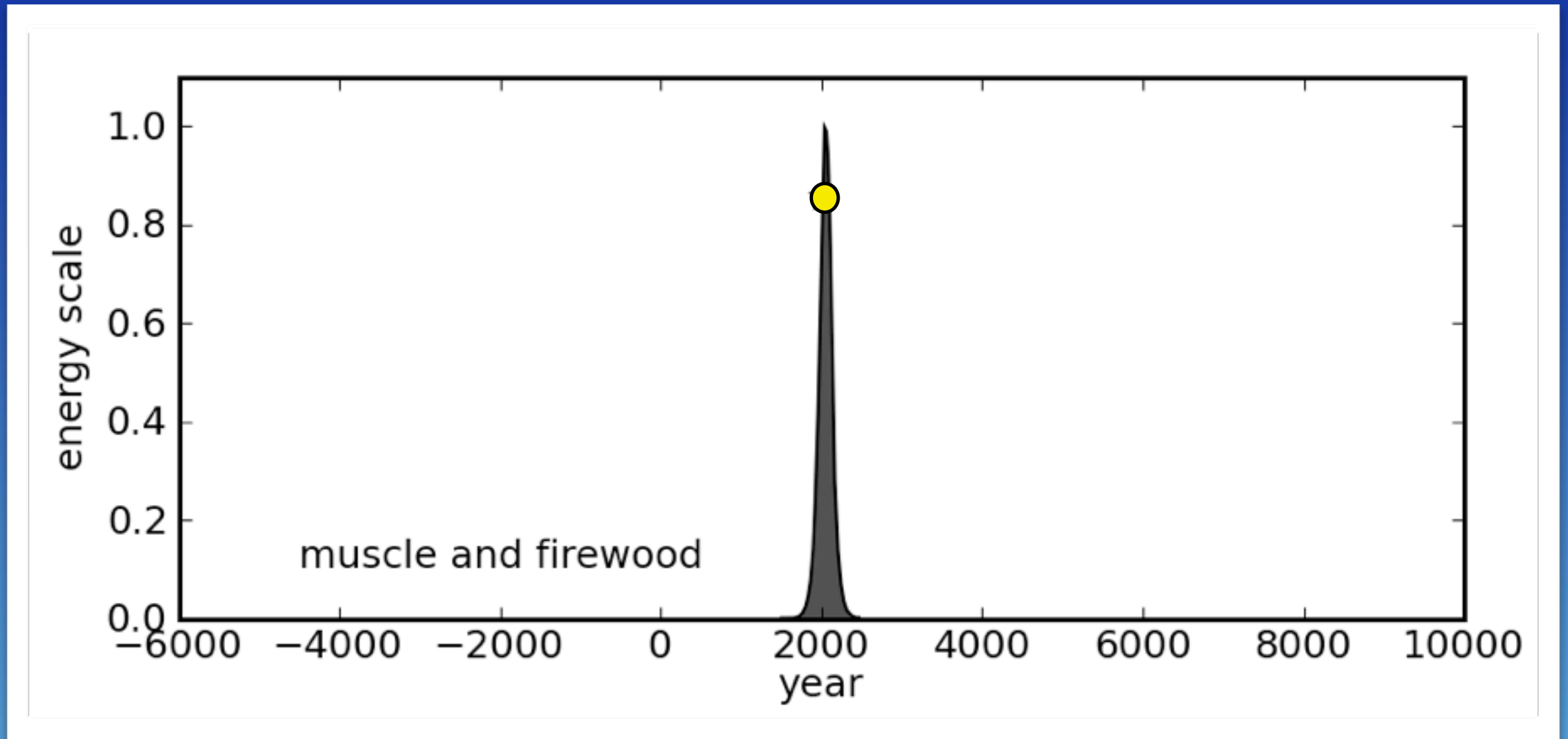


Figure: <http://physics.ucsd.edu/do-the-math>

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16,000,000,000,000 watts

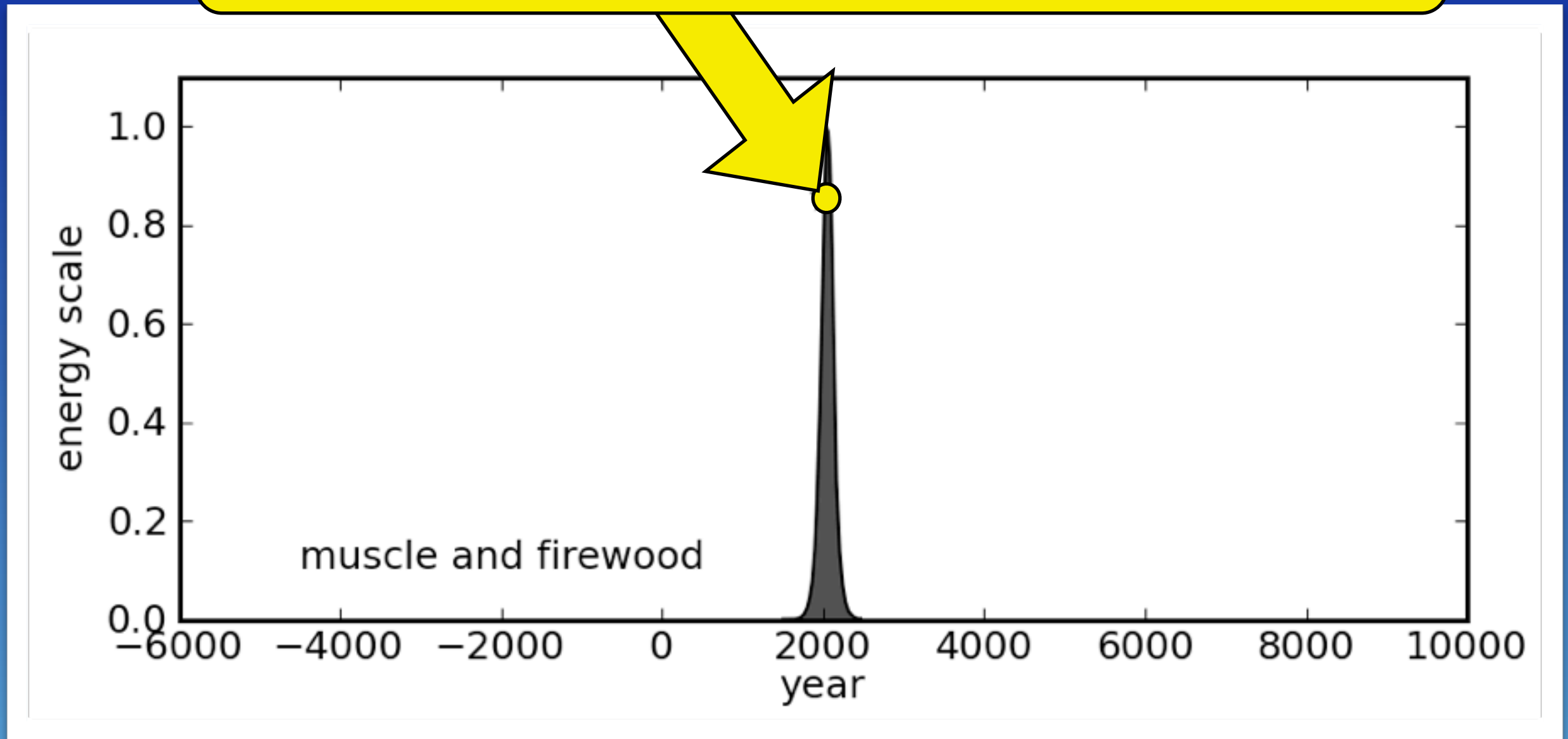


Figure: <http://physics.ucsd.edu/do-the-math>

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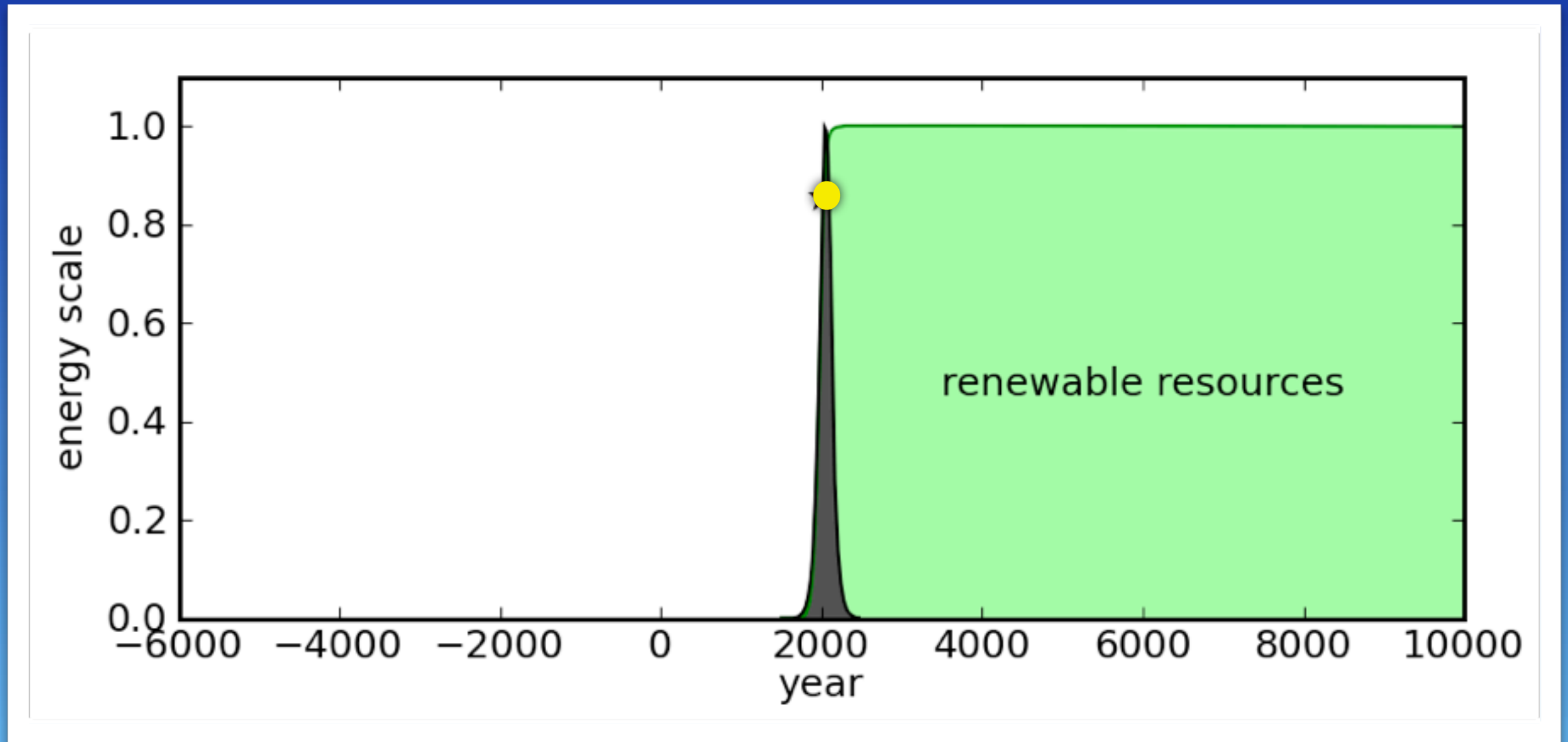


Figure: <http://physics.ucsd.edu/do-the-math>

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What's wrong with this picture?

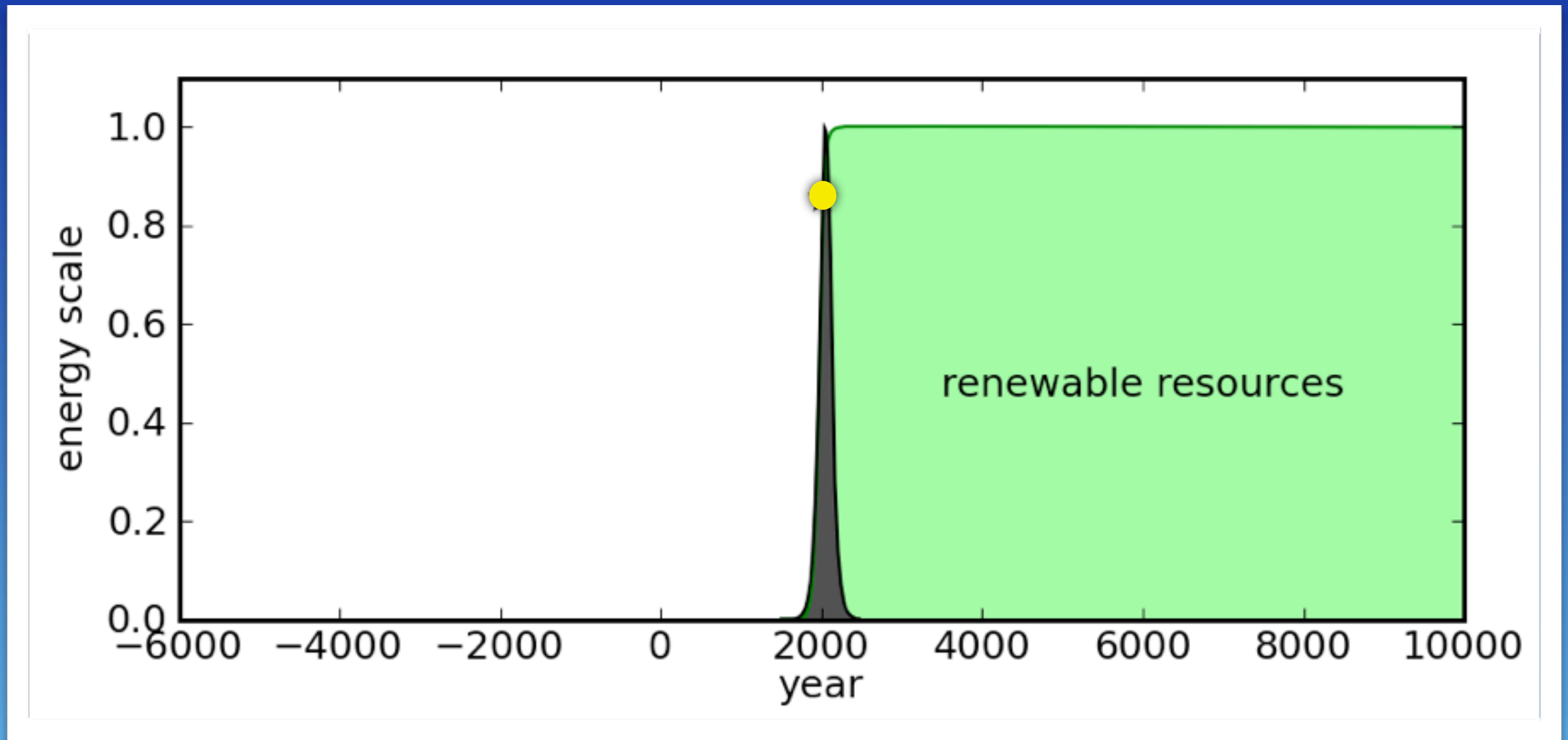


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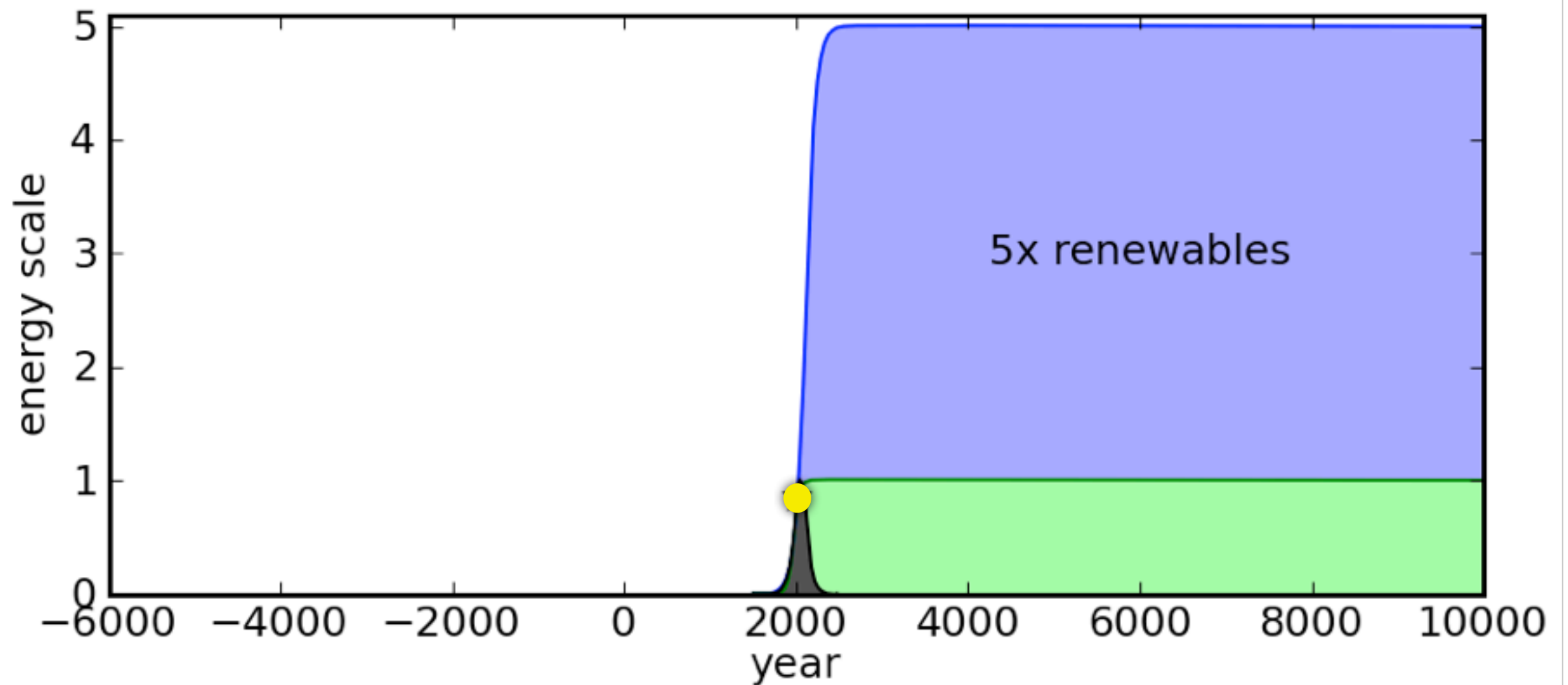


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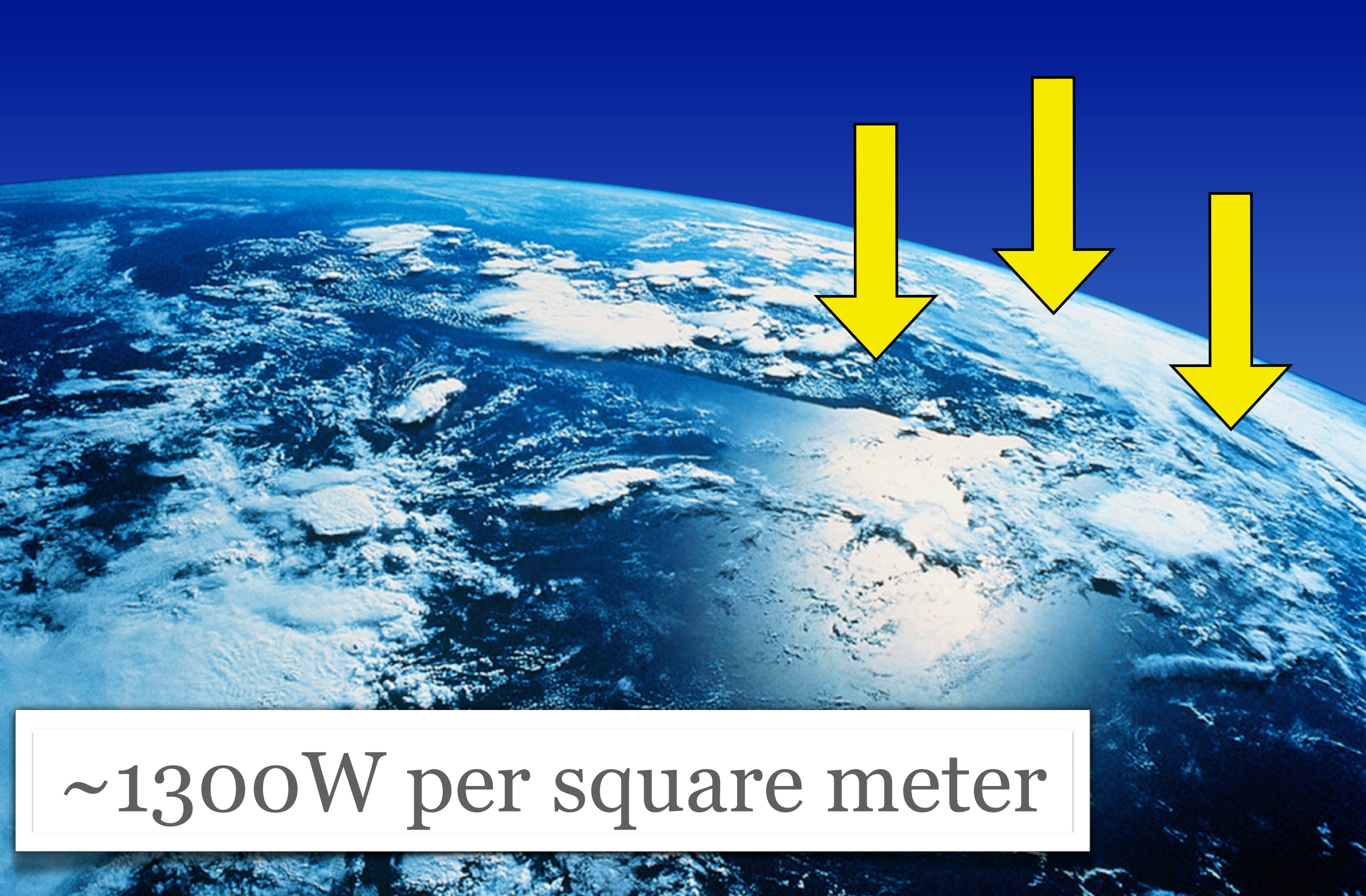
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$\sim 1300\text{W}$ per square meter

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Photo: US DOE



Photo: www.bettergeneration.co.uk

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Photo: USDA Natural Resources Conservation Service

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Photo: ABB Corporate

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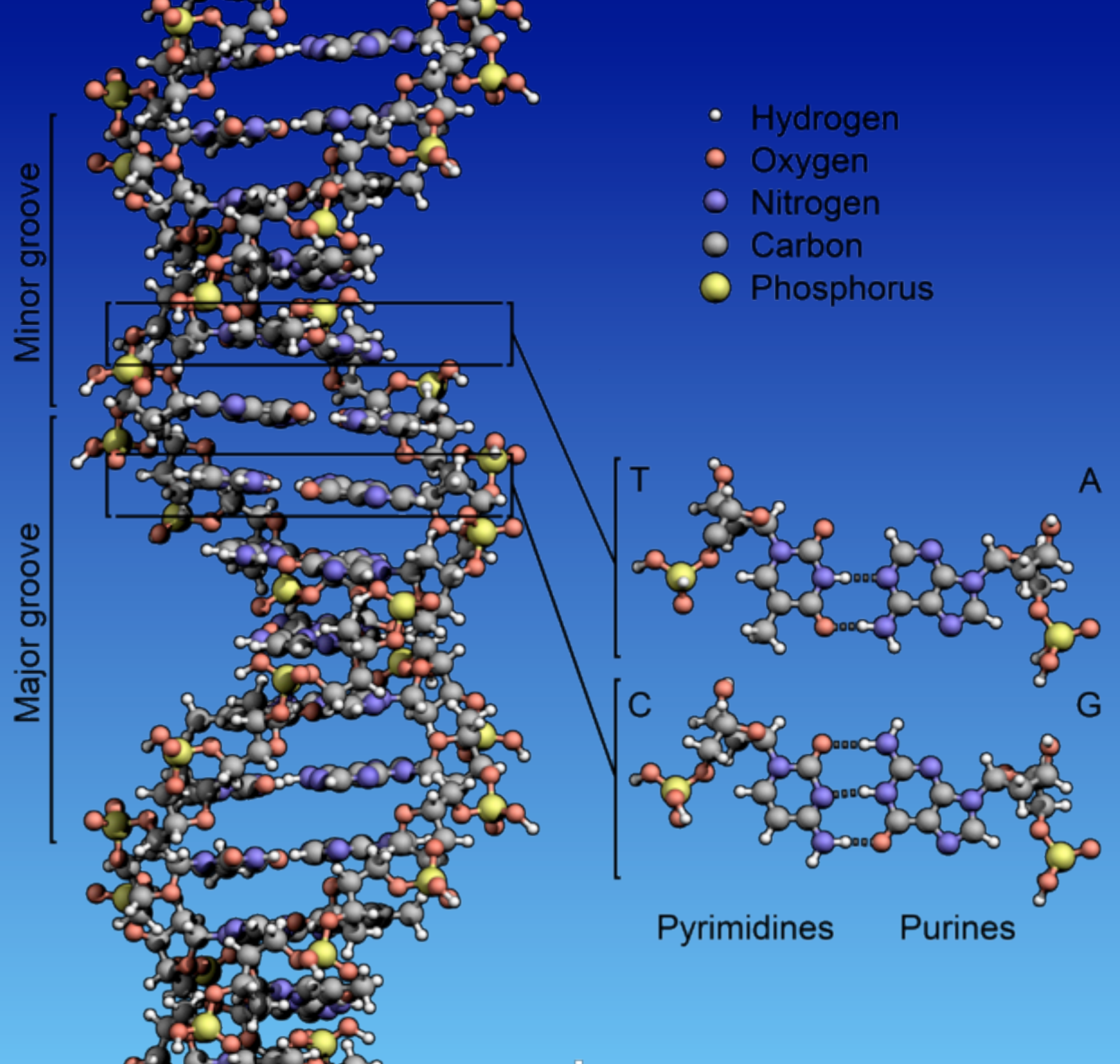
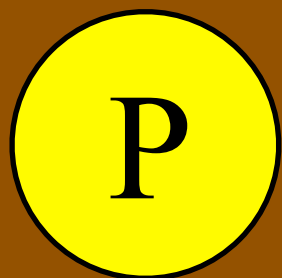
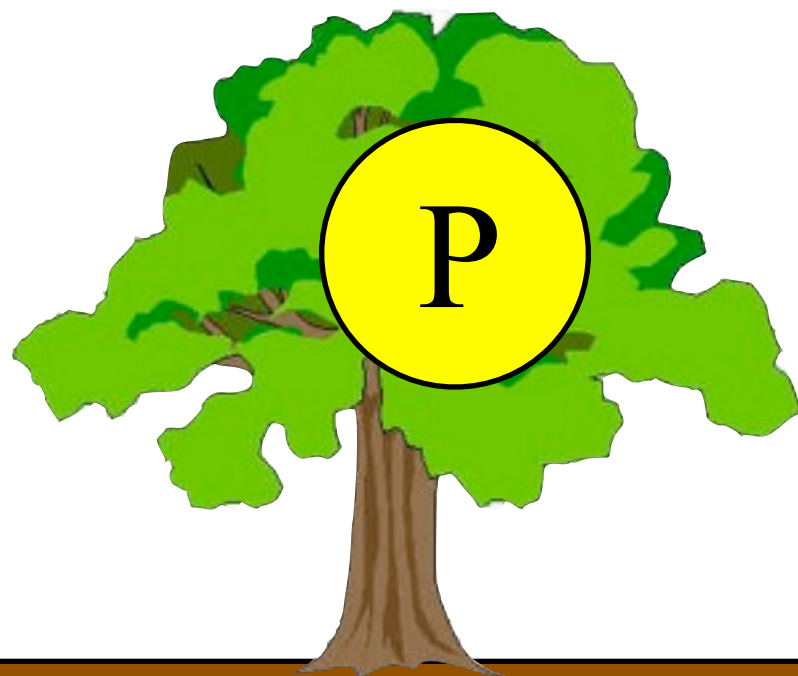


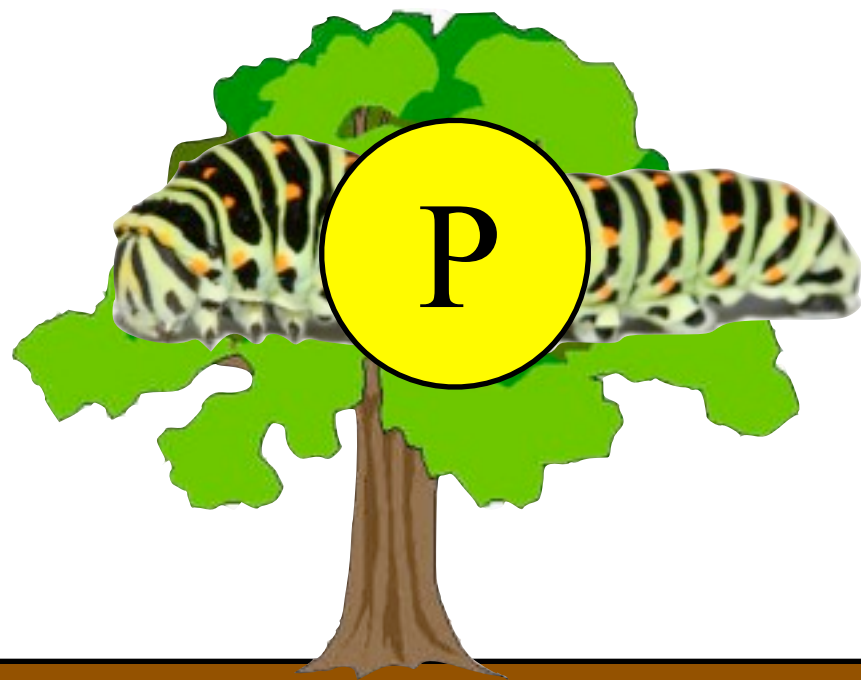
Image: Wikipedia

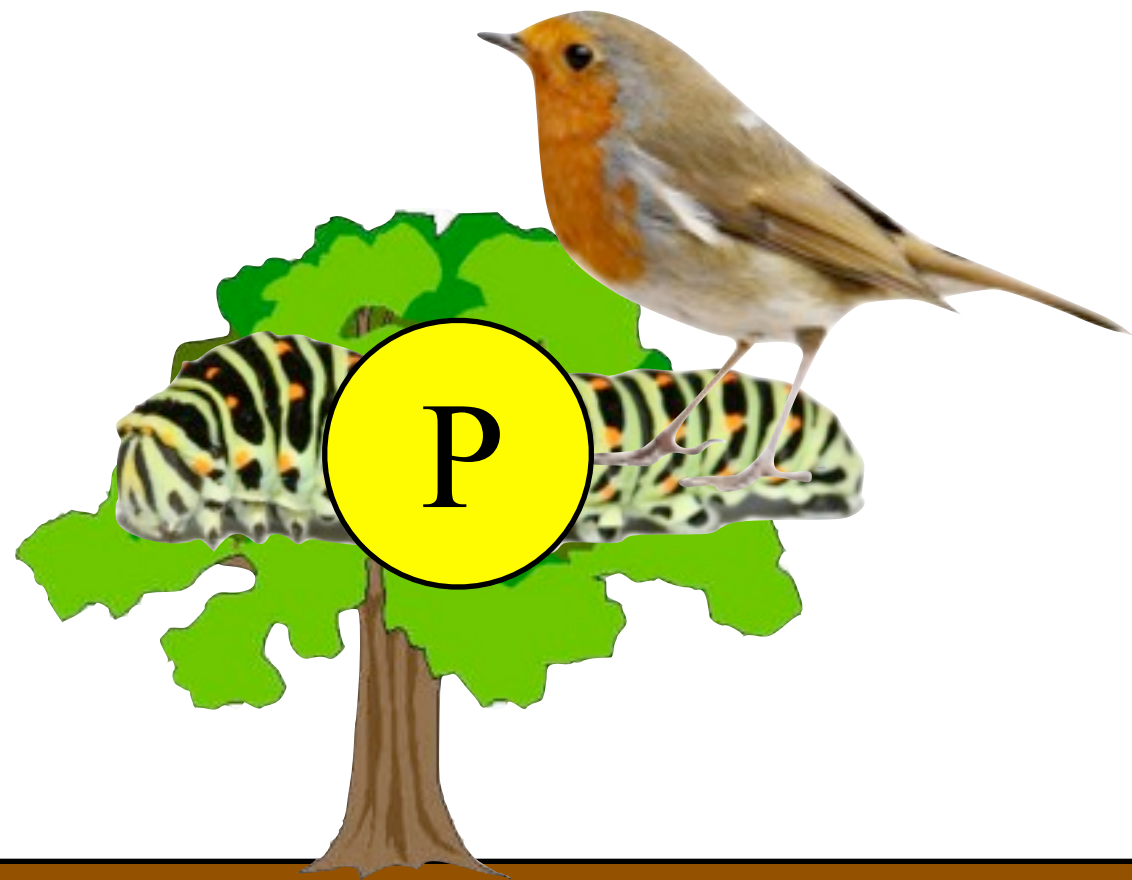
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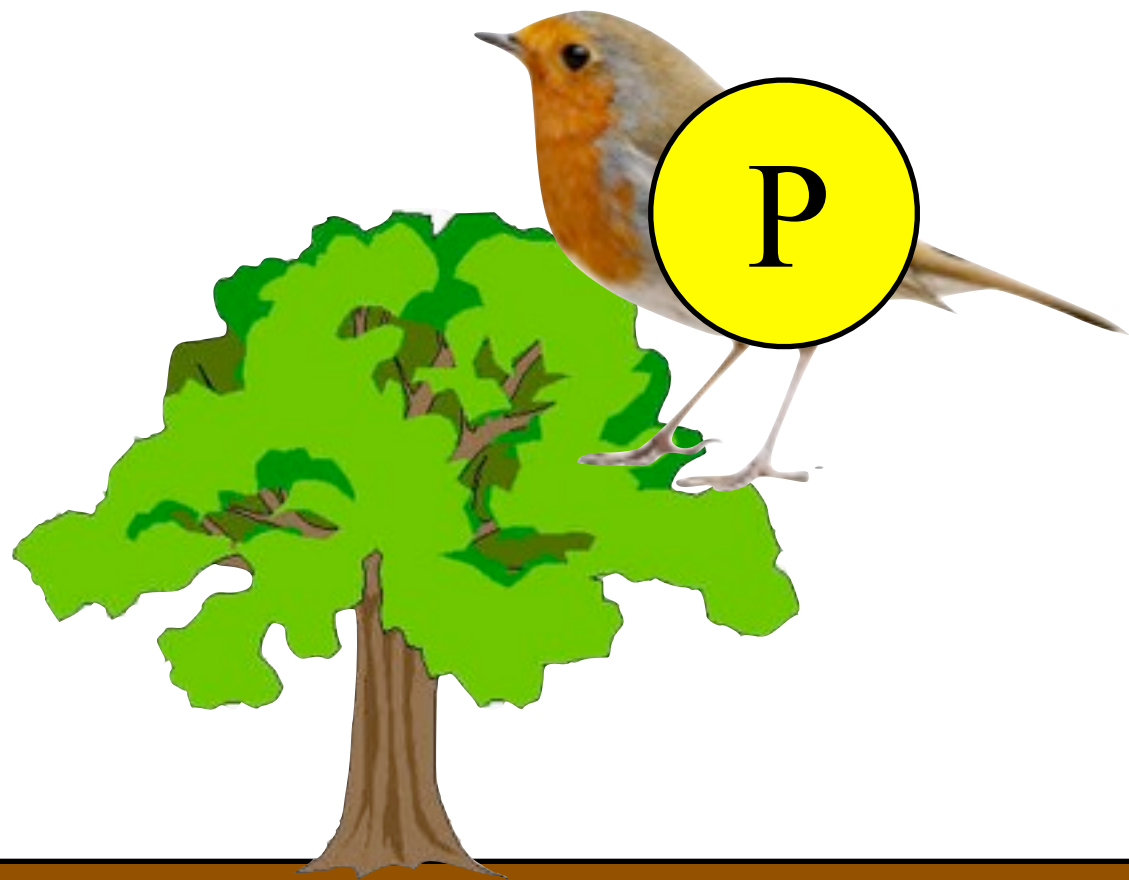


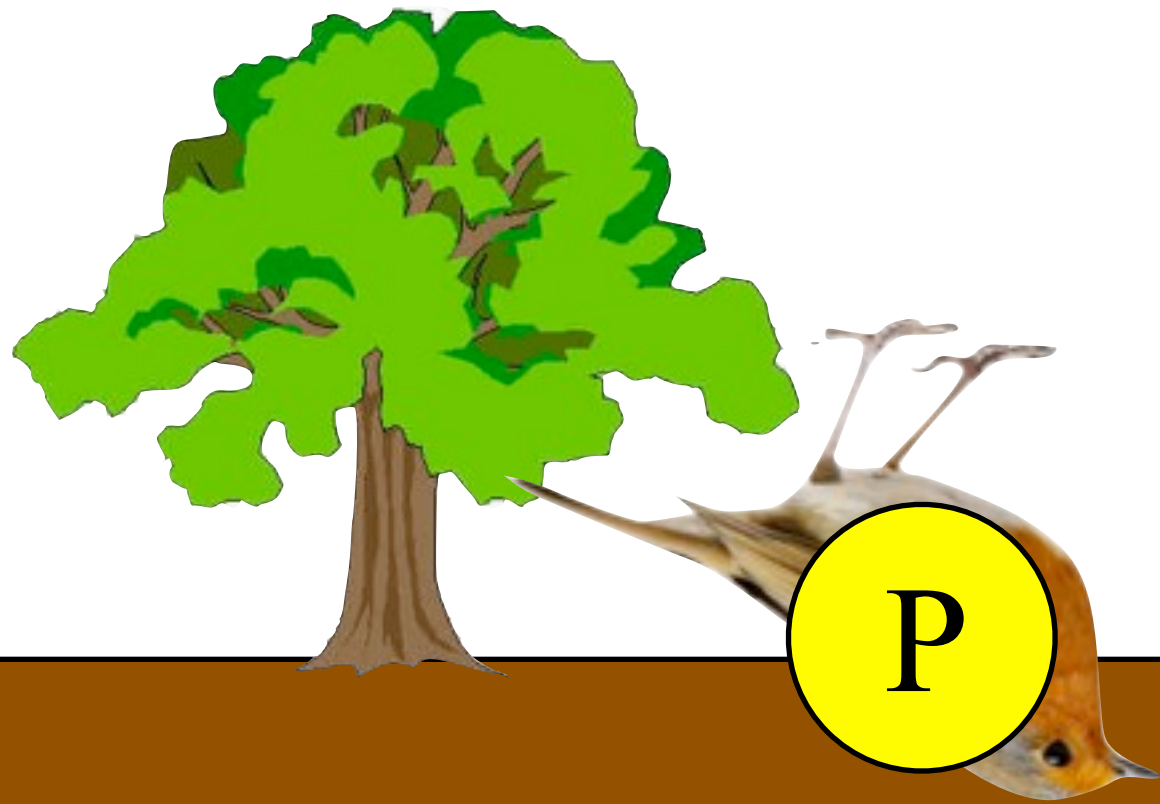


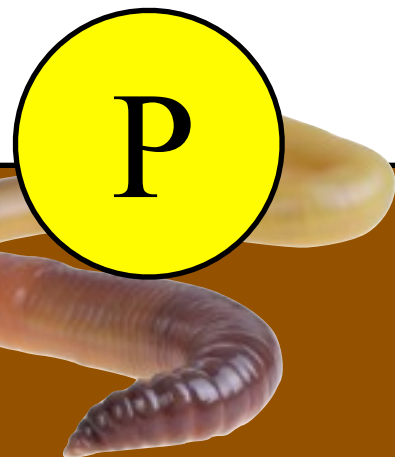


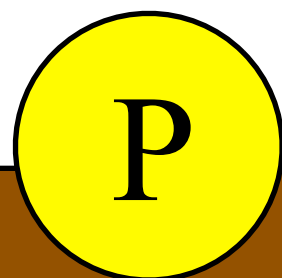
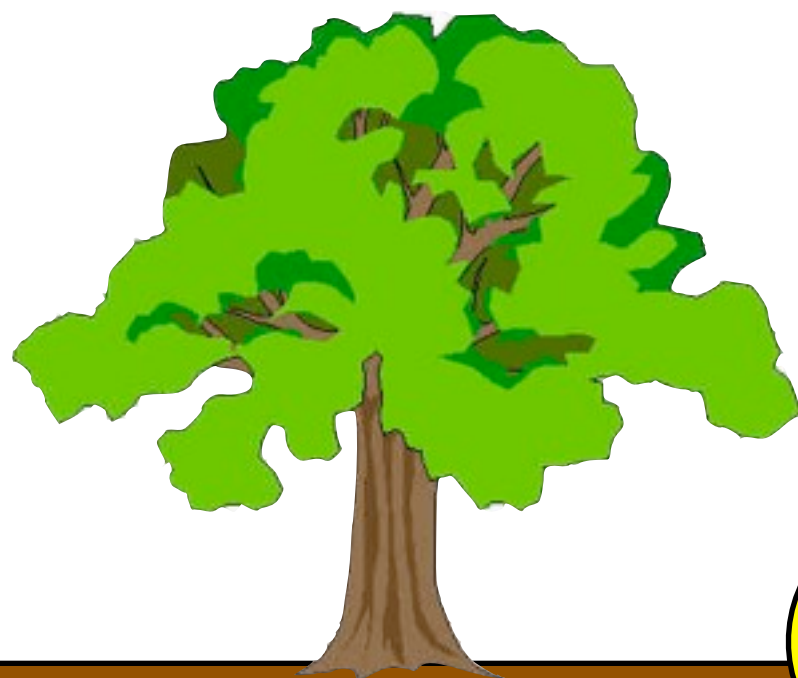


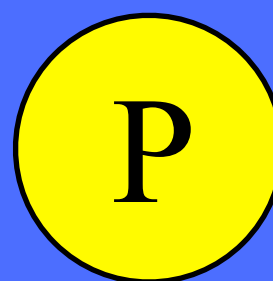




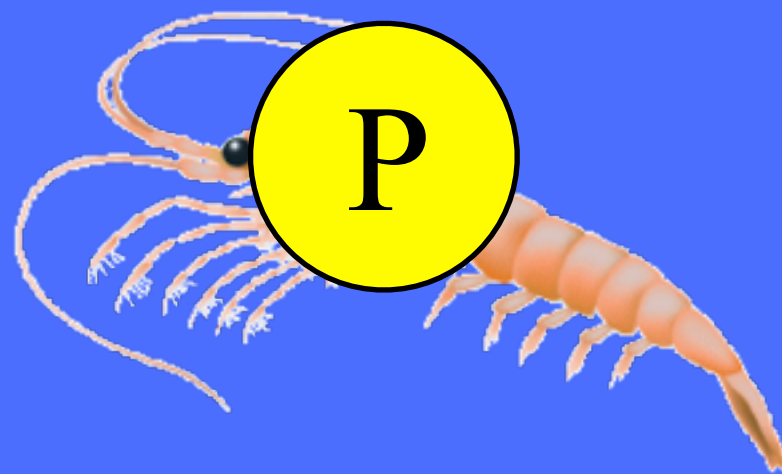


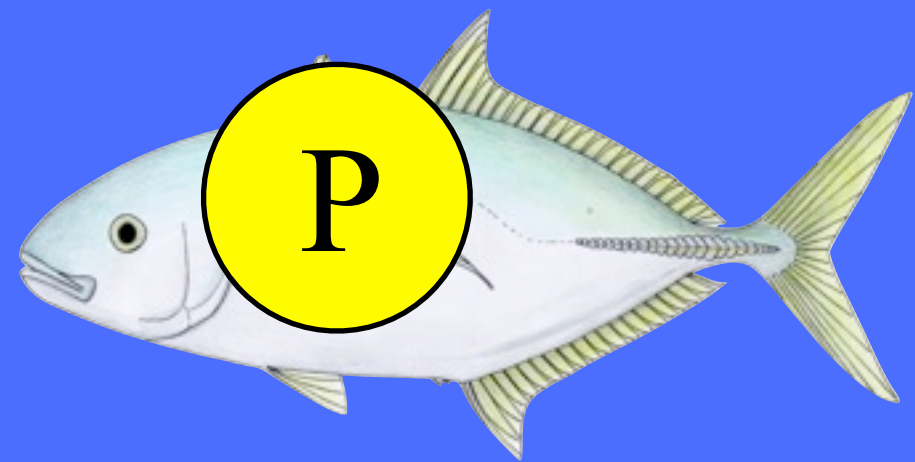


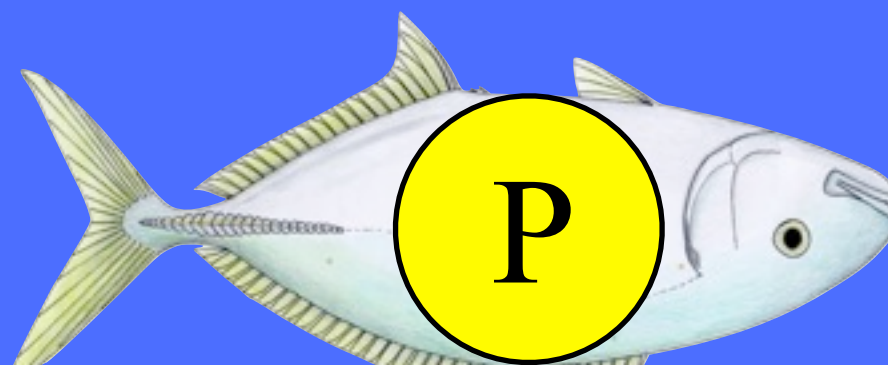




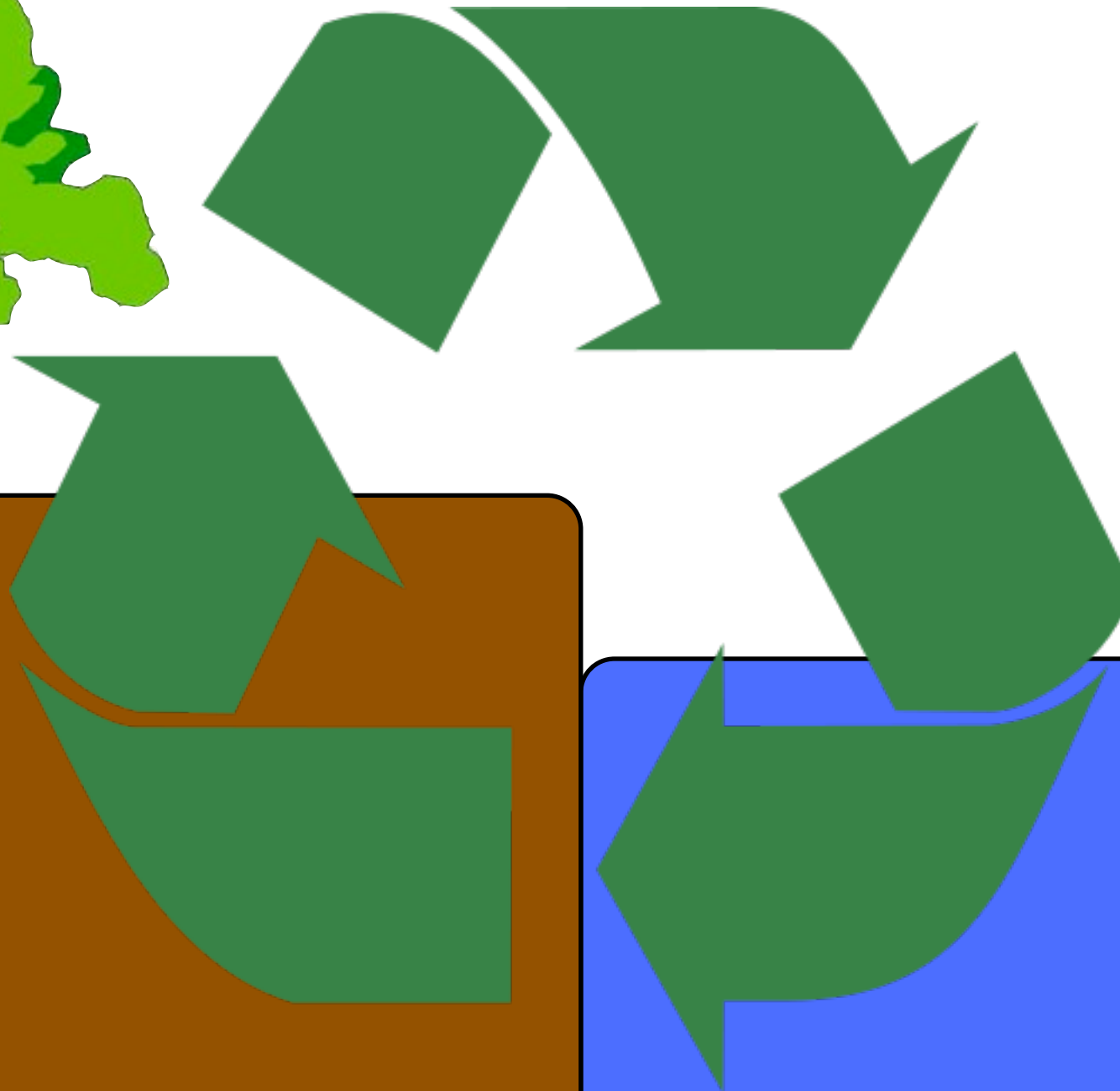






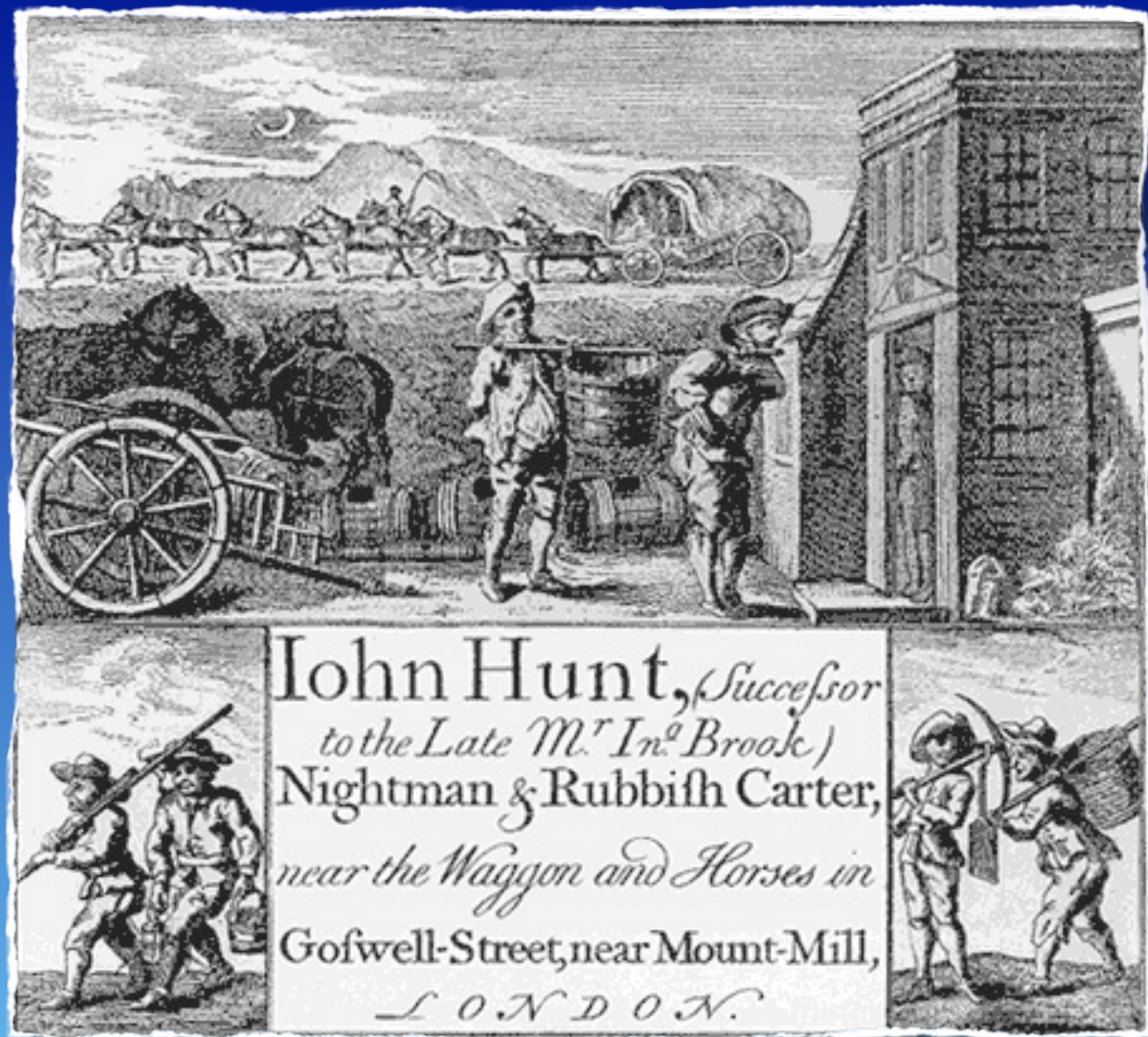















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Bristol Stool Chart

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on the surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges
Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces. Entirely Liquid



FOR
COTTON, CORN, AND ALL SPRING CROPS

ALLISON & ADDISON'S

"STAR BRAND"

GUANO

Spring of 1884.

We again offer this standard trustworthy Fertilizer to Planters and Farmers as having stood the test of **THIRTEEN YEARS'** use in Virginia and North Carolina, on all varieties of soils, and in good and bad seasons.

The "STAR BRAND" GUANO, as a fertilizer for all crops, is justly ranked with the very best made, and no brand has given more general satisfaction.

FOR COTTON

When used on Cotton, it not only starts the plant early and gives it a vigorous growth, but causes it to fruit well and mature early and perfectly, making the finest lint. It does not impoverish the soil, but improves it. There is not a single article which enters into the composition of this Manure which is not a first-rate fertilizing material.

FOR CORN

There is no crop upon which the use of a good commercial fertilizer pays better than corn. In an ordinary season it will pay 100 per cent. profit on the cost—and, in case of drought, many instances have come to our knowledge in which, in consequence of the early start and vigorous growth given the crop by the fertilizer, it has made a large yield, while other fields, of as good or better land, were cut off by the drought and scarcely yielded anything.

Its very high grade, fine condition, and low price commend it to those farmers who want to use the best fertilizer for the above crops.

Every bag is Guaranteed to be of Standard quality.

ALLISON & ADDISON, - - Manufacturers,
RICHMOND, VA.

[OVER.]



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Photo: Wikipedia

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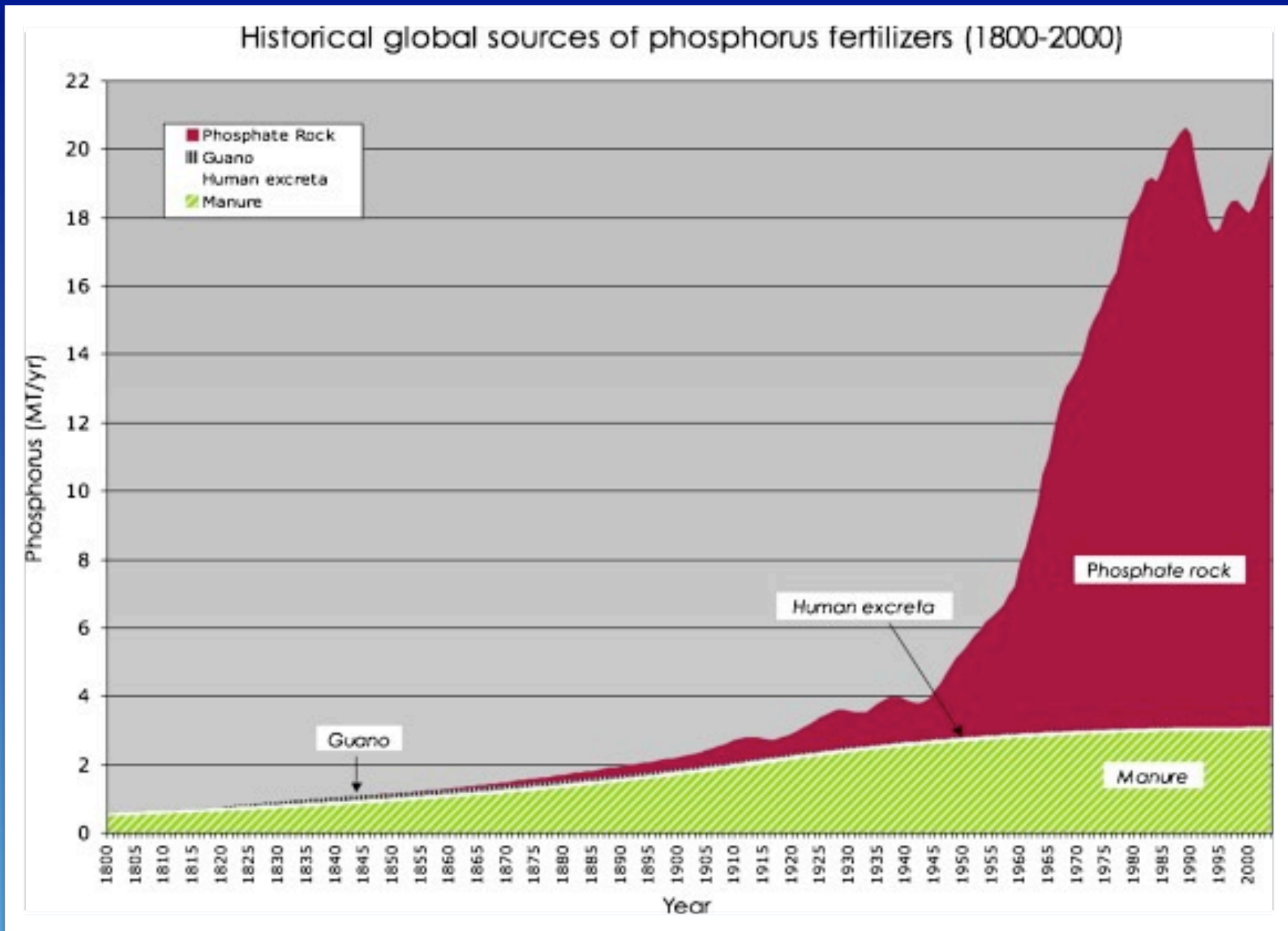


Figure: Cordel, D., Drangert, J-O. and White, S. (2009) *Global Environmental Change* 19:2 292-305

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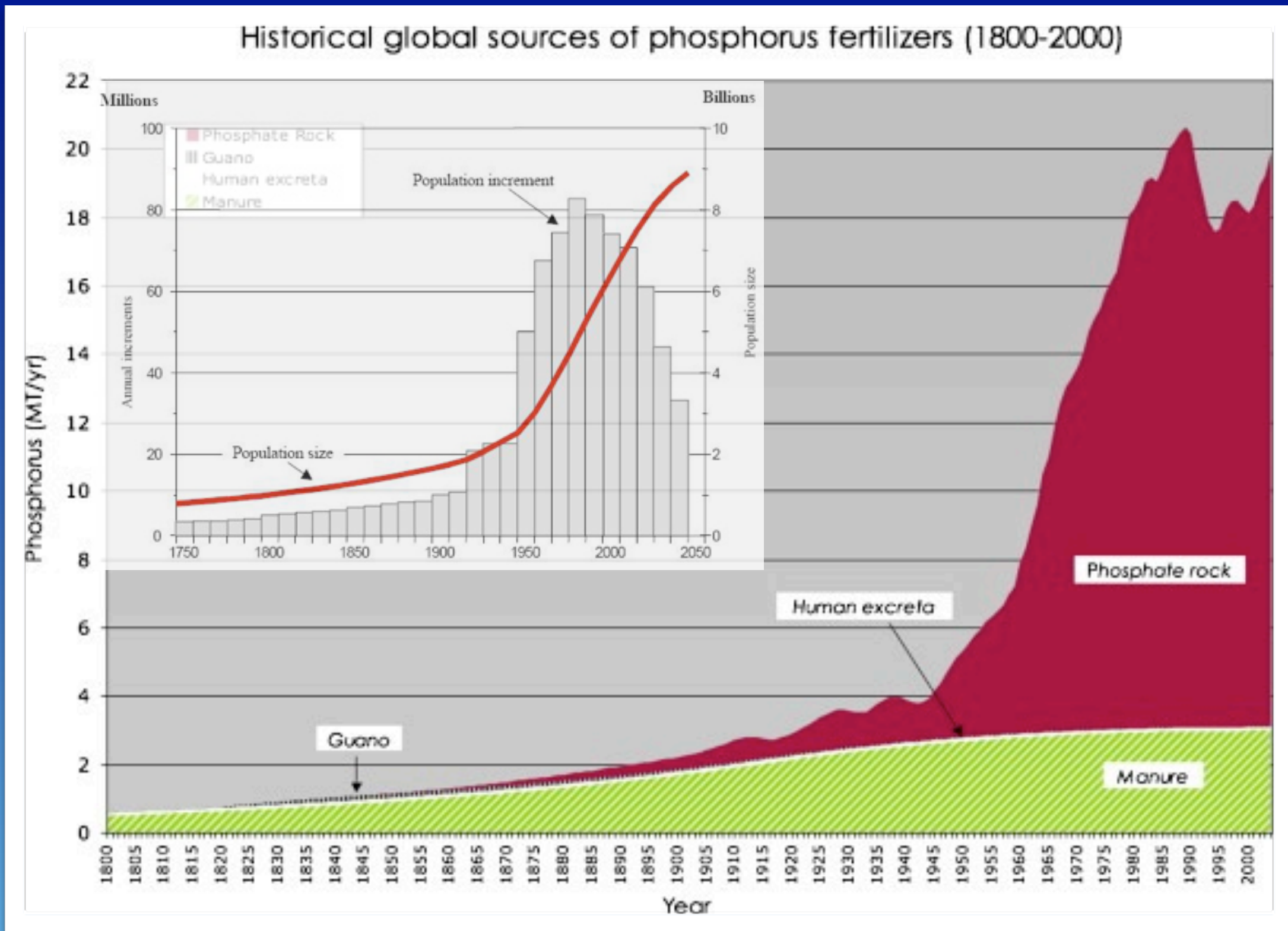
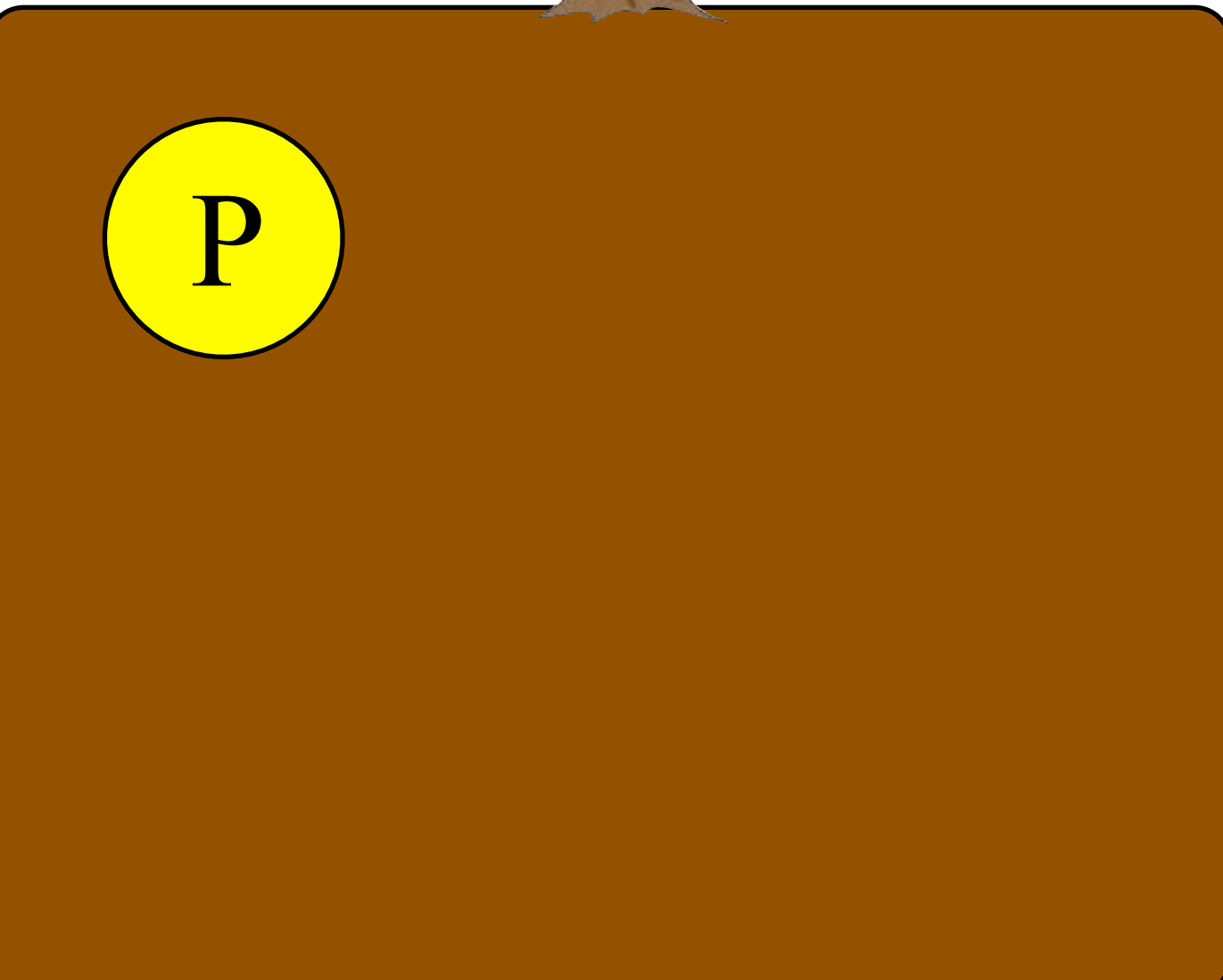
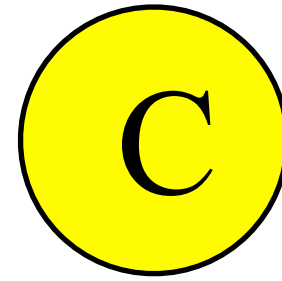
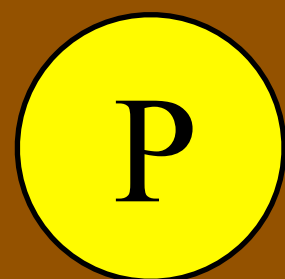
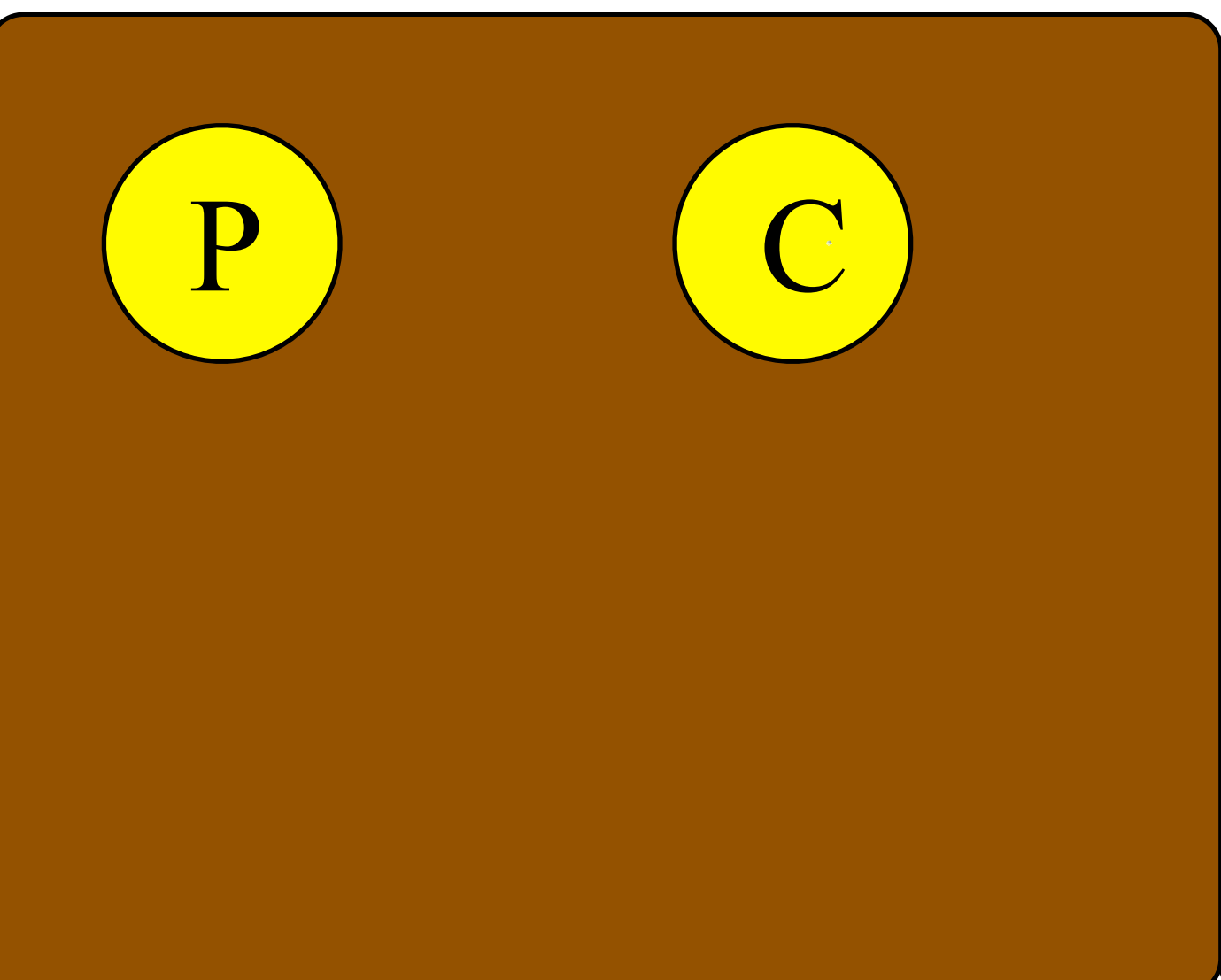


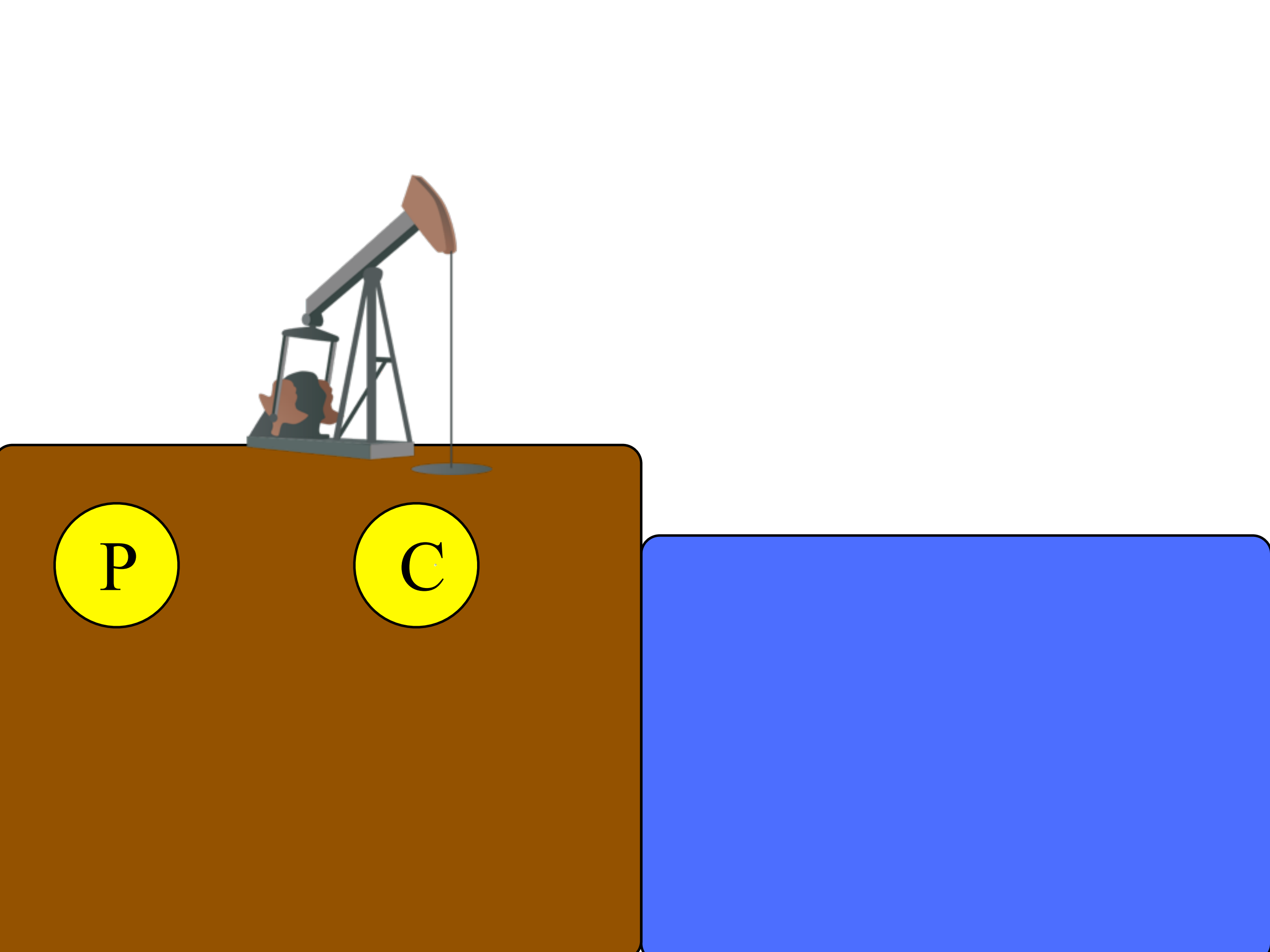
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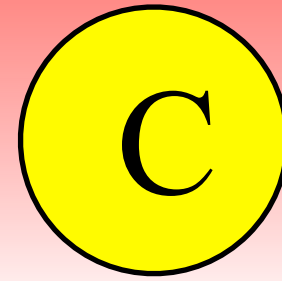


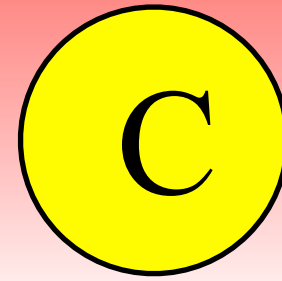


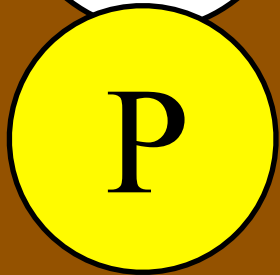
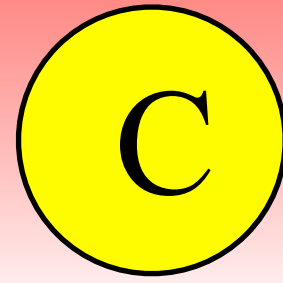


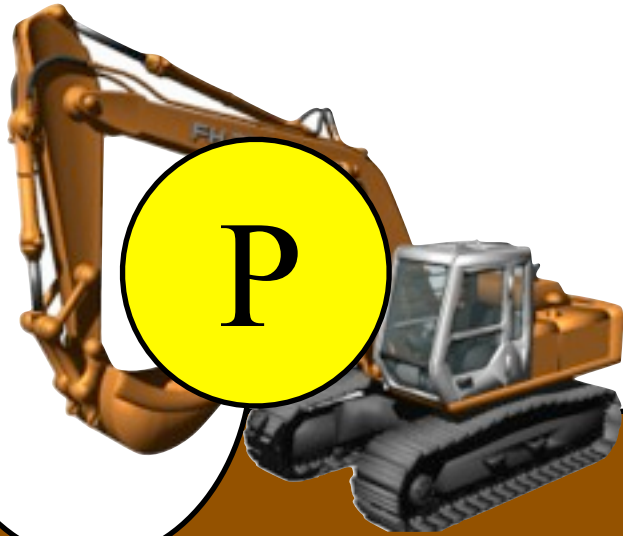
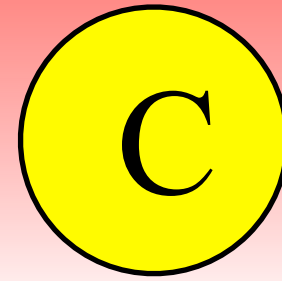
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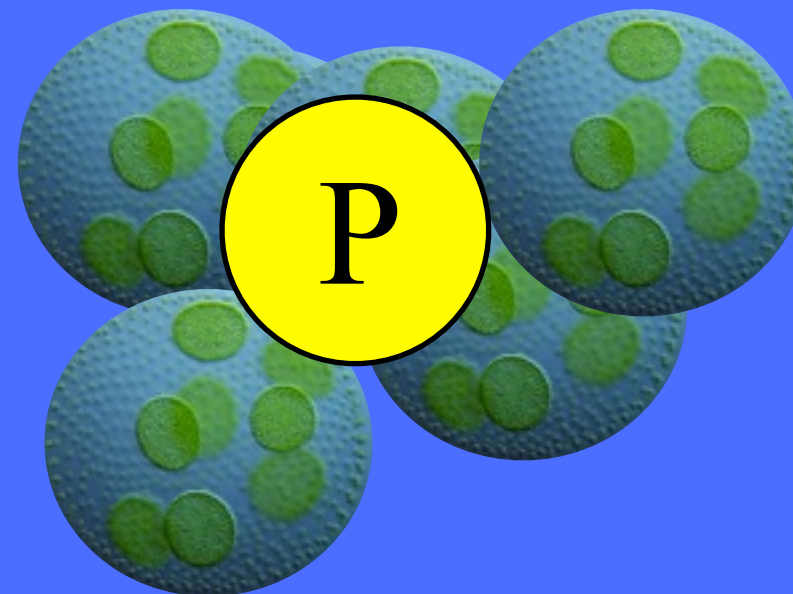
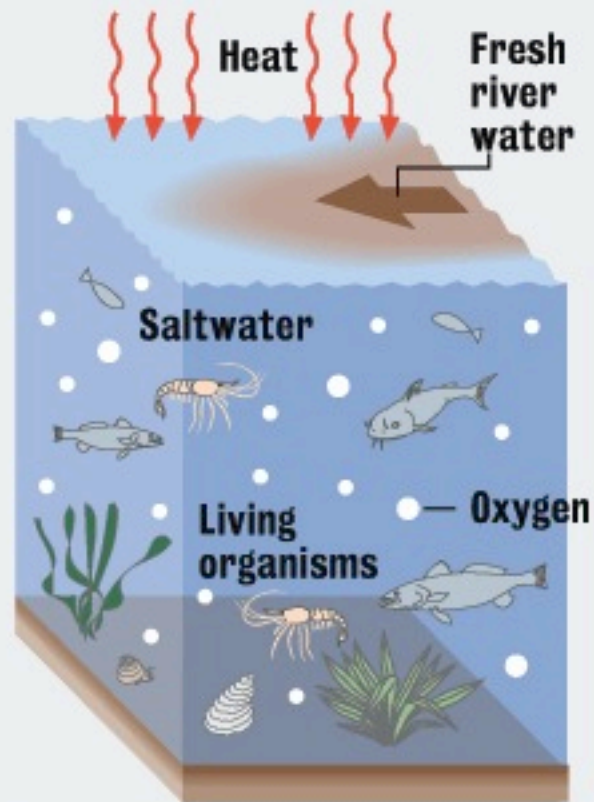




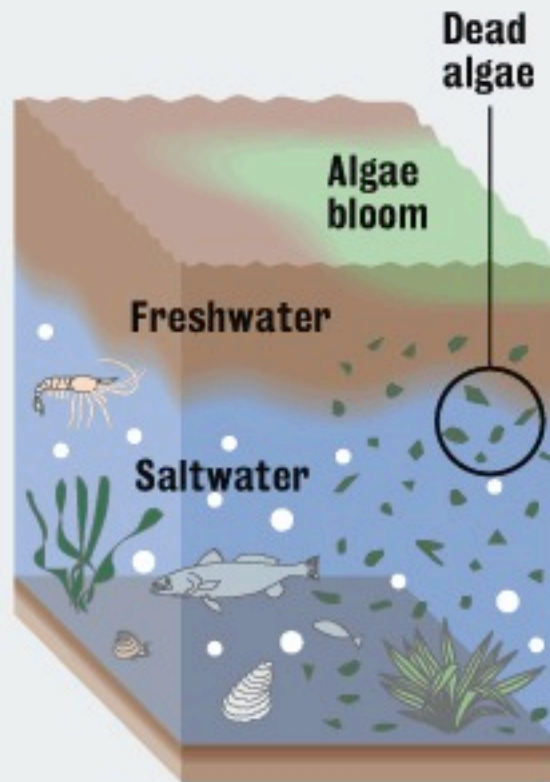
Photo: MSNBC

HOW THE DEAD ZONE FORMS

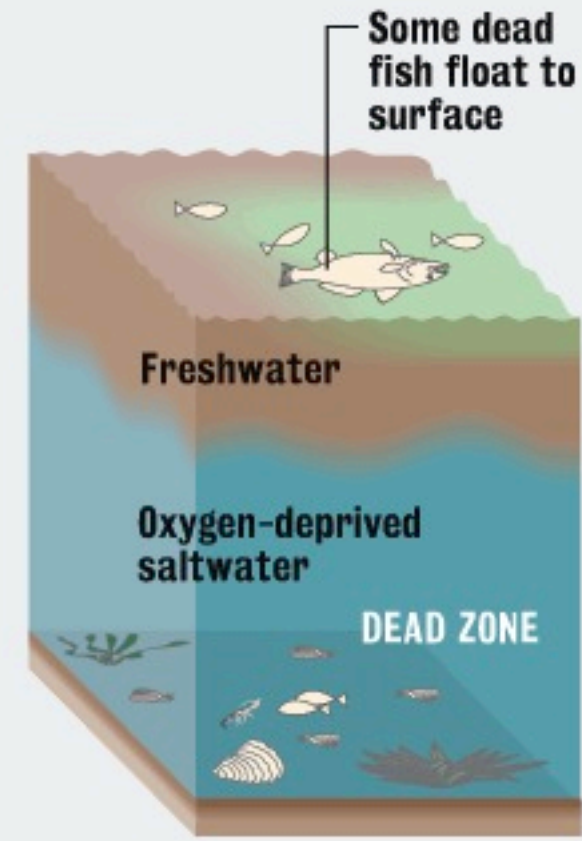


1 During the spring, sun-heated freshwater runoff from the Mississippi River creates a barrier layer in the Gulf, cutting off the saltier water below from contact with oxygen in the air.

Source: Staff research



2 Nitrogen and phosphorus from fertilizer and sewage in the freshwater layer ignite huge algae blooms. When the algae die, they sink into the saltier water below and decompose, using up oxygen in the deeper water.



3 Starved of oxygen and cut off from resupply, the deeper water becomes a dead zone. Fish avoid the area or die in massive numbers. Tiny organisms that form the vital base of the Gulf food chain also die. Winter brings respite, but spring runoffs start the cycle anew.

STAFF GRAPHIC BY DAN SWENSON

Image: Dan Swenson www.nola.com

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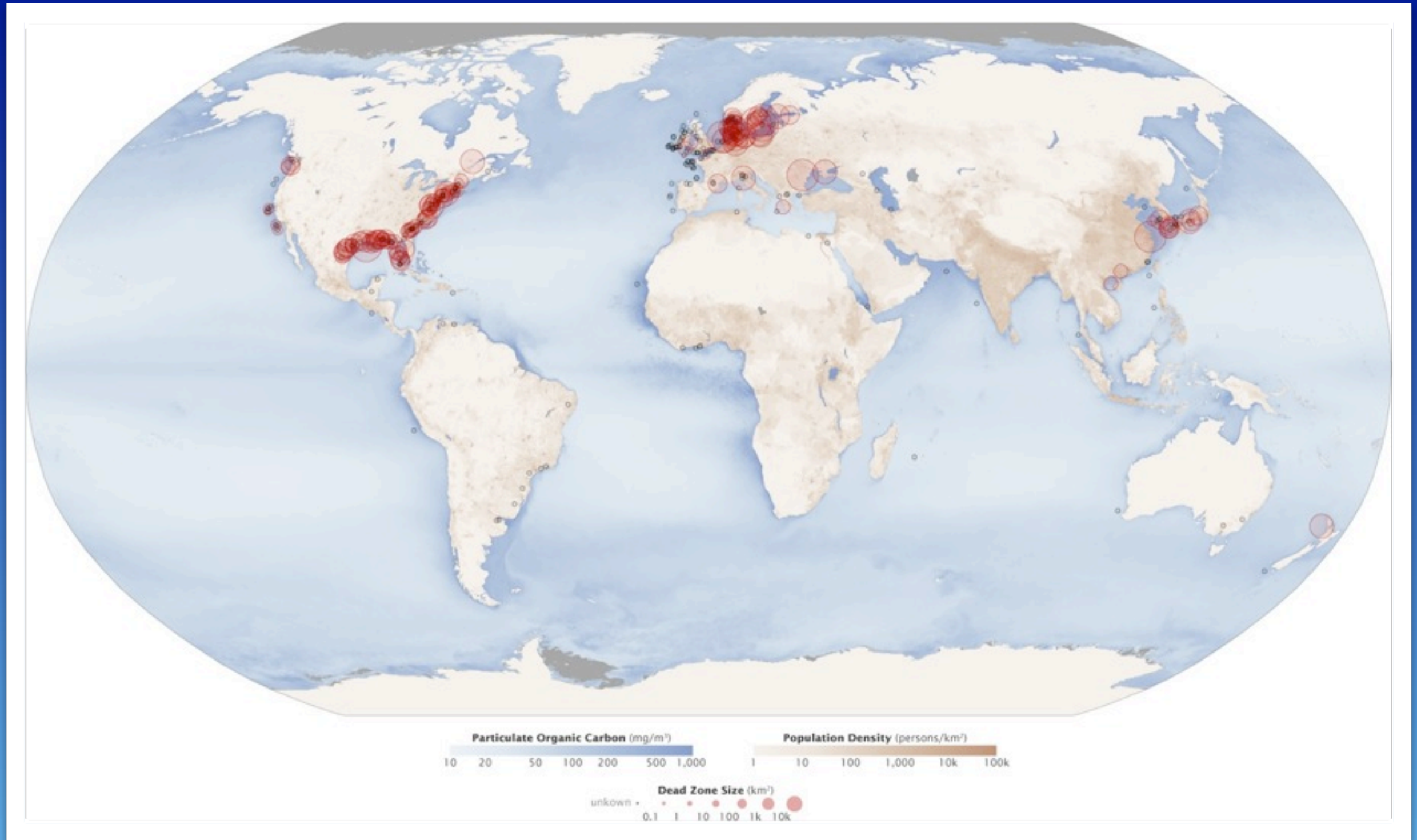


Image: Wikipedia

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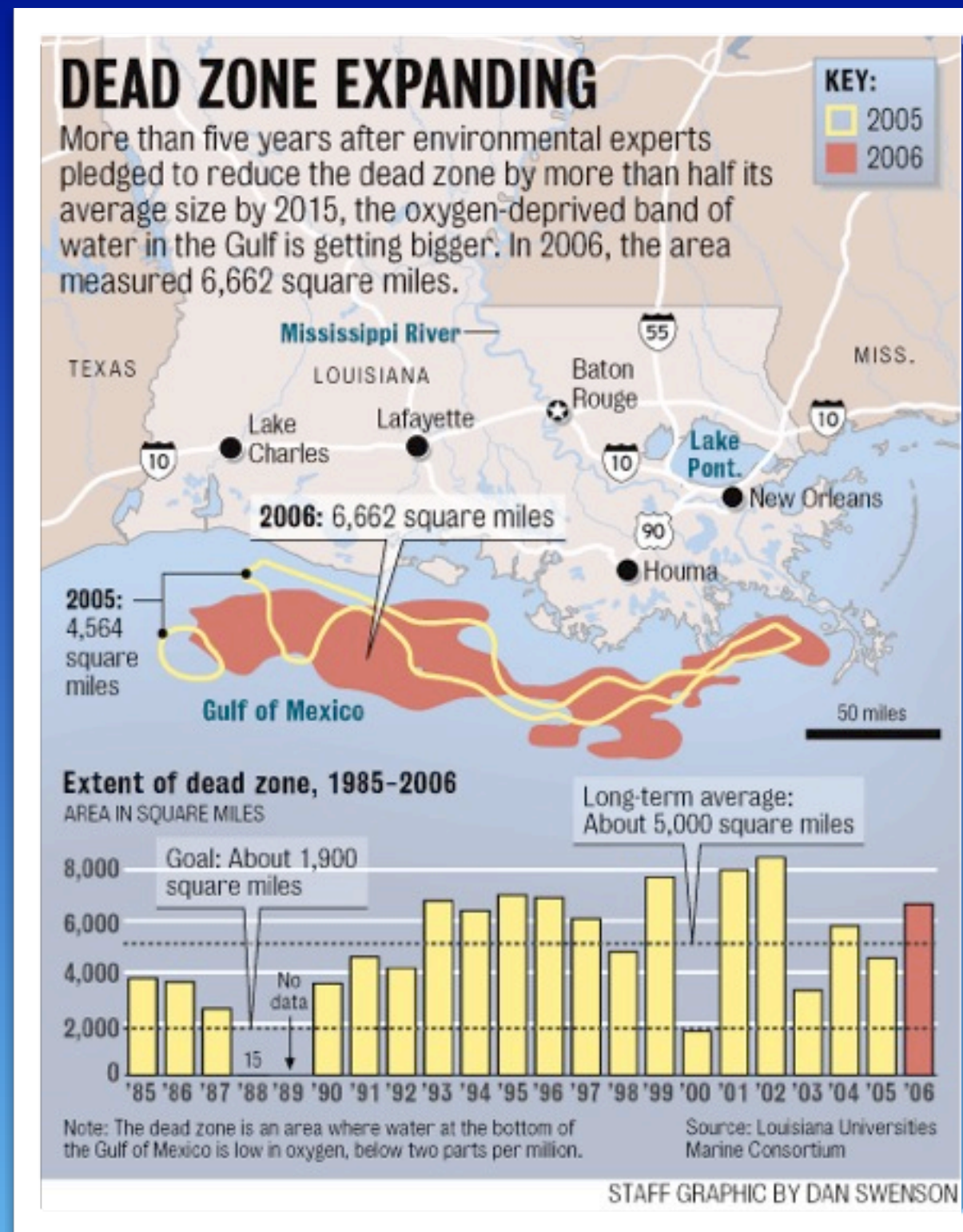
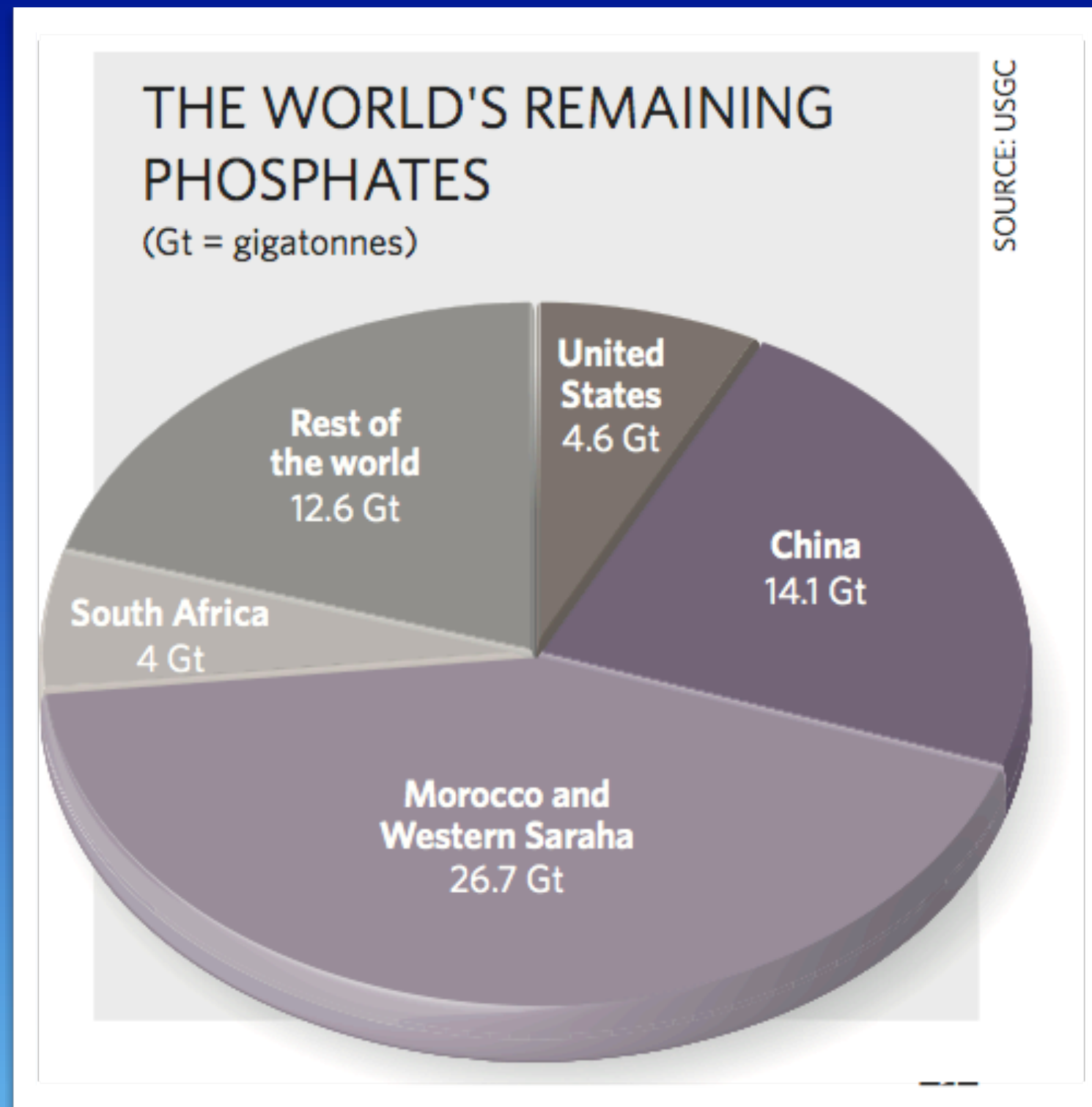


Image: Dan Swenson www.nola.com

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Gilbert, N. (2009) *Nature* 461:8 716-718

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NEWS FEATURE

NATURE|Vol 461|8 October 2009



THE DISAPPEARING NUTRIENT

Gilbert, N. (2009) *Nature* 461:8 716-718

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Southampton



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World Phosphate Rock Reserves and Resources

IFDC

Presented at
Center for Strategic and International Studies
September 22, 2010

S. Van Kauwenbergh
Geologist and Principal Scientist
Research and Development Division
IFDC



www.ifdc.org

Resources 300 years

STOCKS FLOWS!!!

Global Challenges

UNIVERSITY OF
Southampton

World Phosphate Rock Reserves and Resources

Presented at
Center for Strategic and International Studies
September 22, 2010

S. Van Kauwenbergh
Geologist and Principal Scientist
Research and Development Division
IFDC



Resources 300 years

STOCKS FLOWS!!!

Peak reserve 30 years

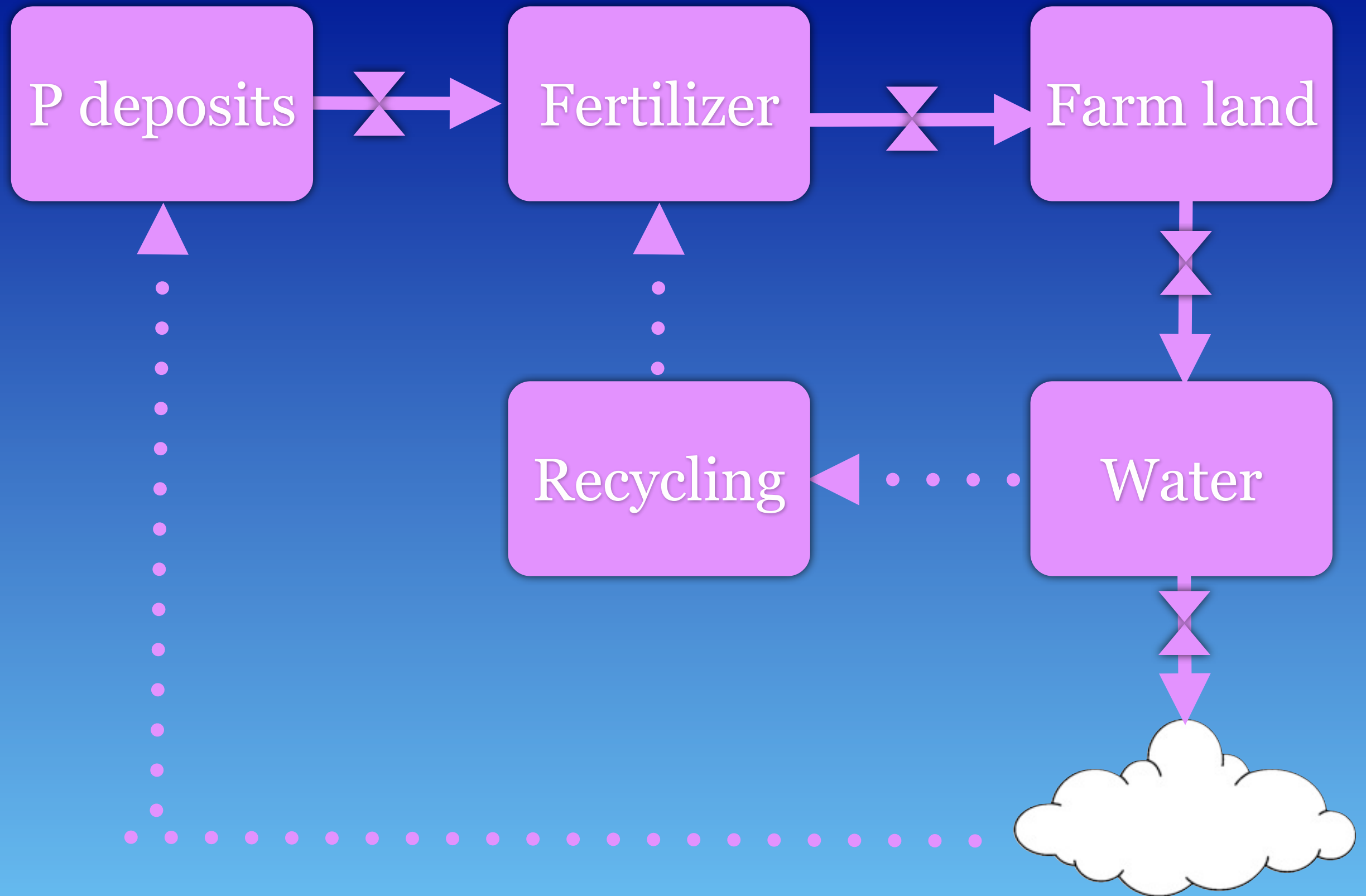


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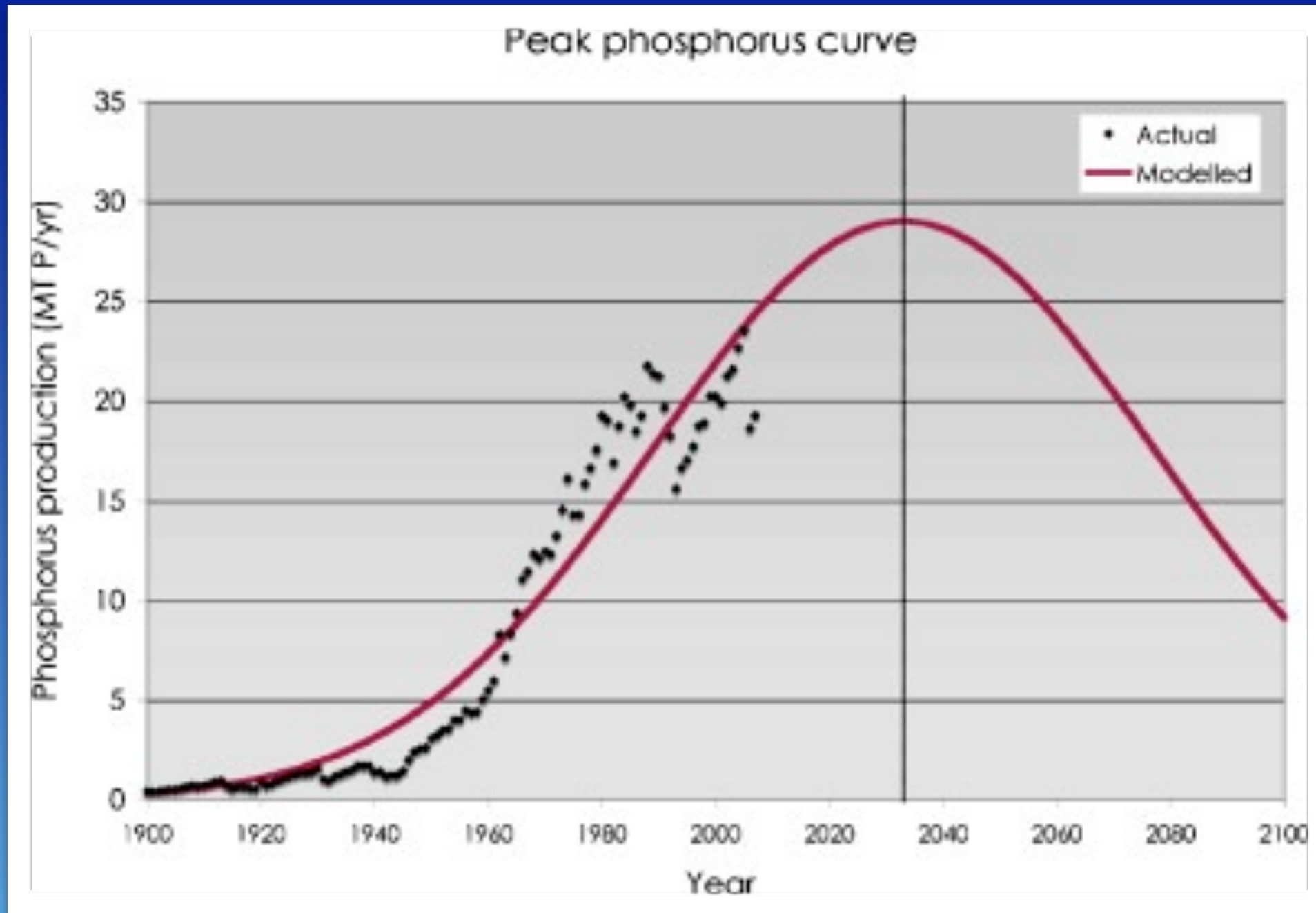
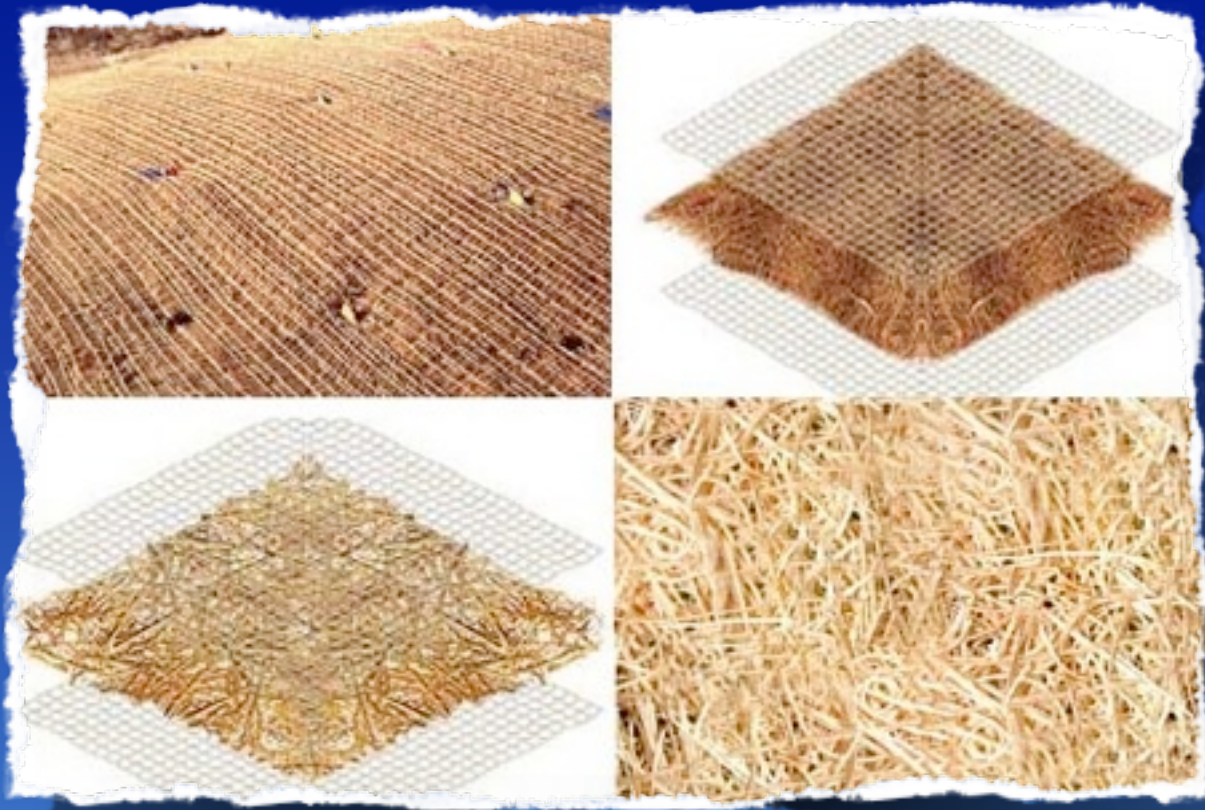


Figure: Cordel, D., Drangert, J-O. and White, S. (2009) *Global Environmental Change* 19:2 292-305

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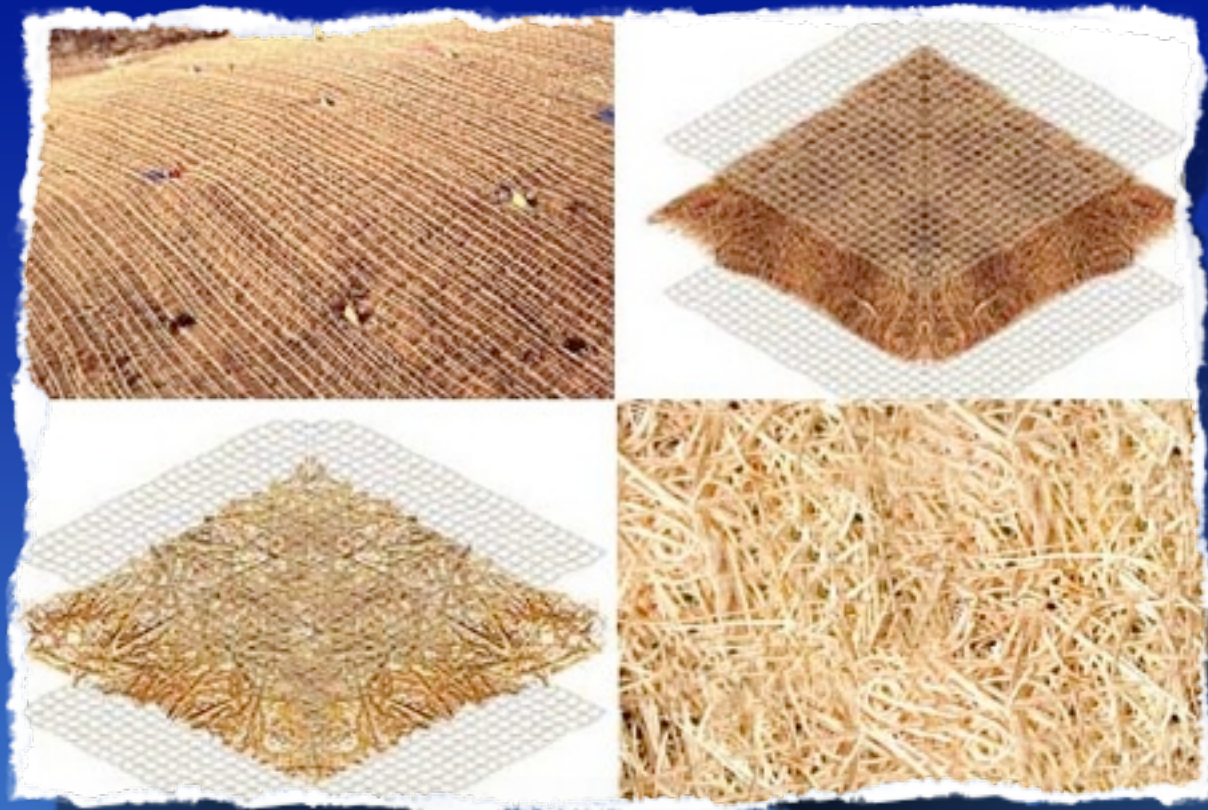


Photo: Karim Nice, www.howstuffworks.com

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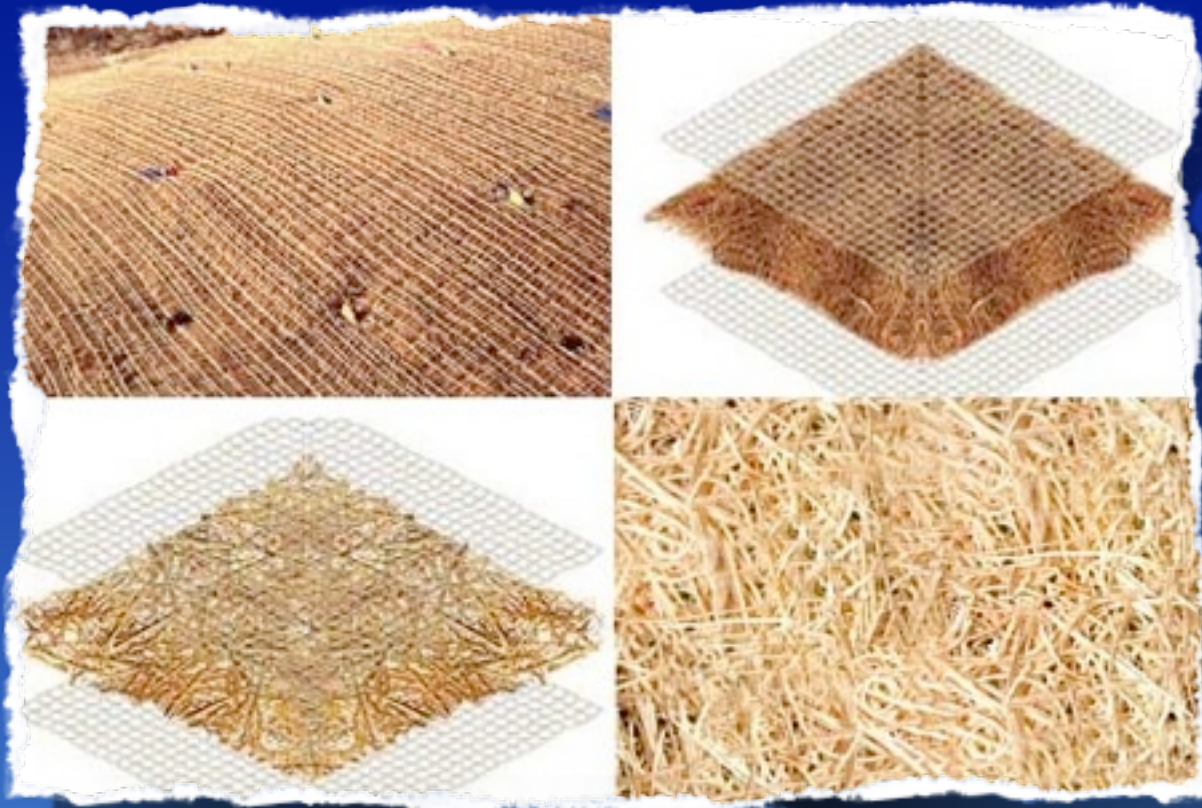


Photo: Dena Fam



Photo: Karim Nice, www.howstuffworks.com

Global Challenges

For 21/3/2014

The quiz on Friday
will be based on this?

Read

Thinking in Systems pages 145-165

Read

The Guardian: Industrial civilisation
heading for inevitable collapse

<http://www.theguardian.com/environment/earth-insight/2014/mar/14/nasa-civilisation-irreversible-collapse-study-scientists>