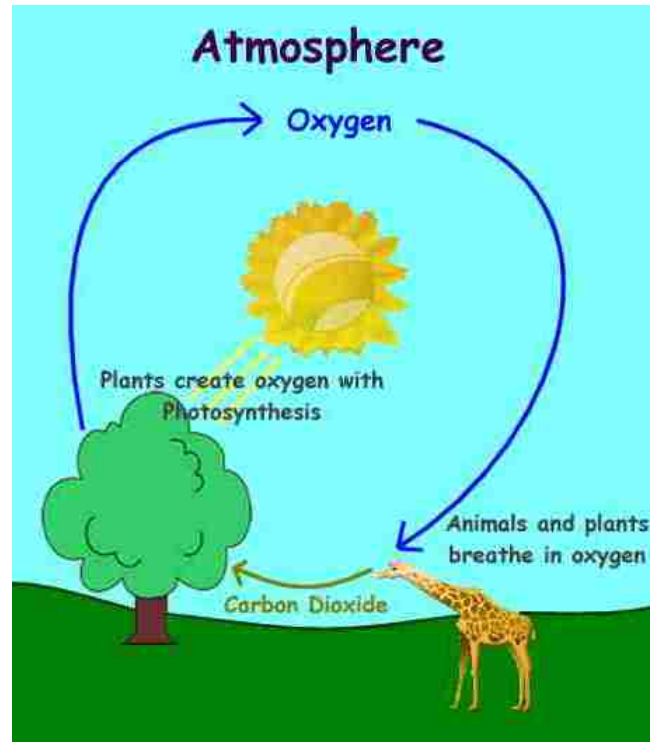


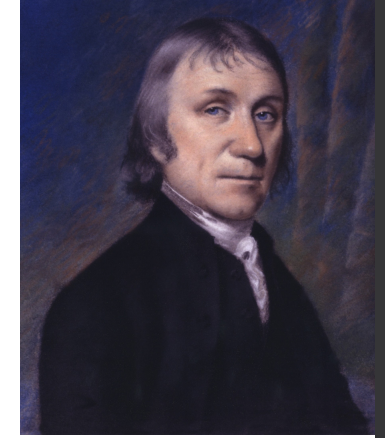
The many facets of oxygen in life

Harinath Chakrapani, IISER Pune

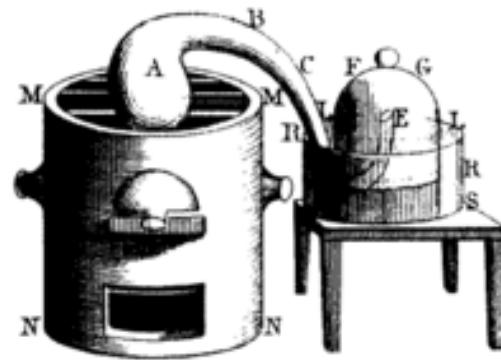
Oxygen... Essential for life on earth!



Discovering Oxygen



- <https://www.youtube.com/watch?v=R7GdH4O3050>
- Lavoisier, Priestley and Scheele had key roles to play in the discovery of oxygen
- Evolution of theories - Phlogiston
- Scientific Method: Reproducibility and quantitation – Lavoisier

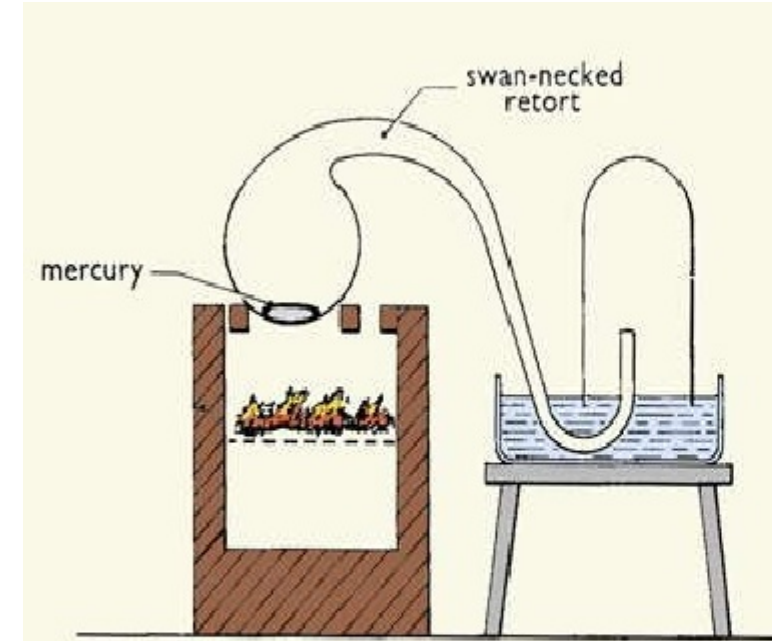
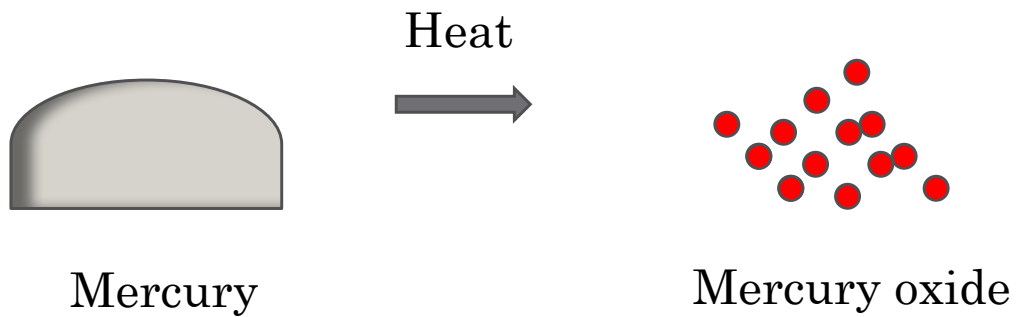


<https://en.wikipedia.org>

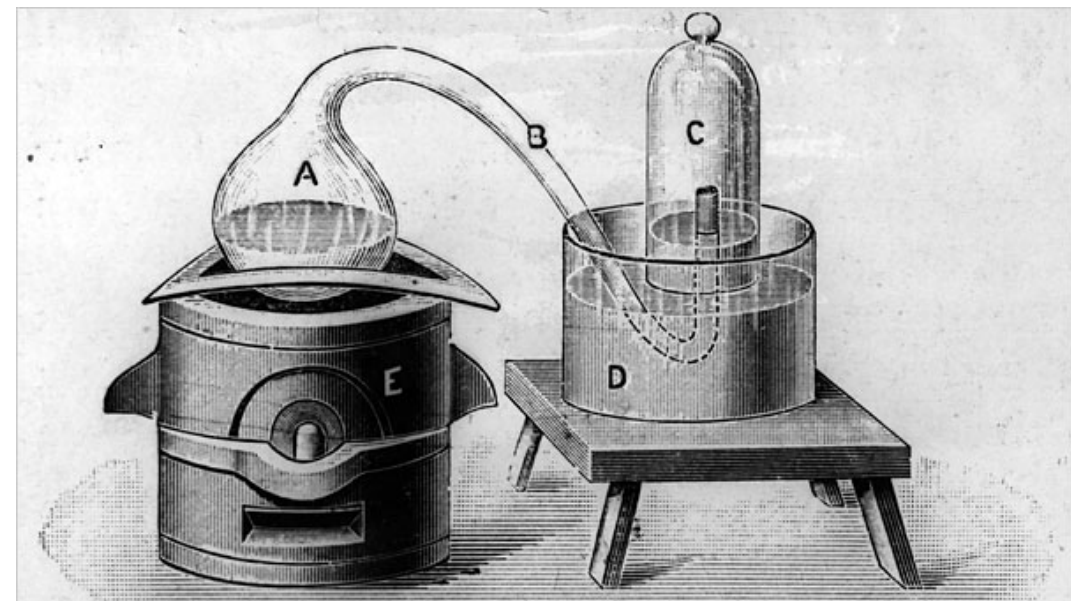


Heating Mercury

- Heating mercury in air gave mercury oxide (HgO)

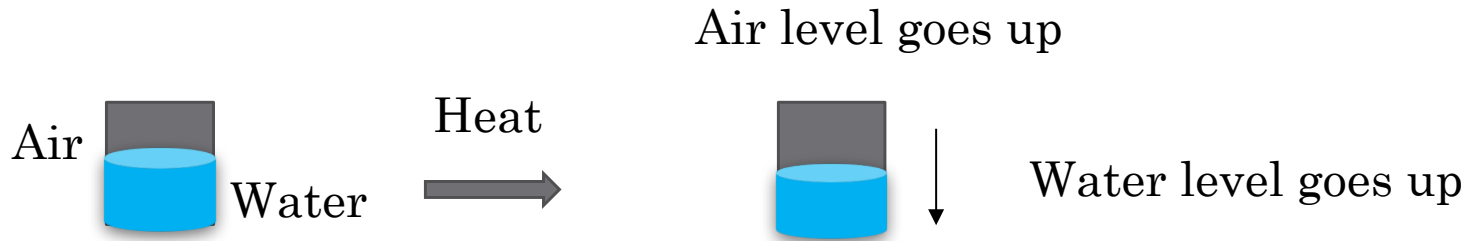


1/5th of the volume of air is consumed

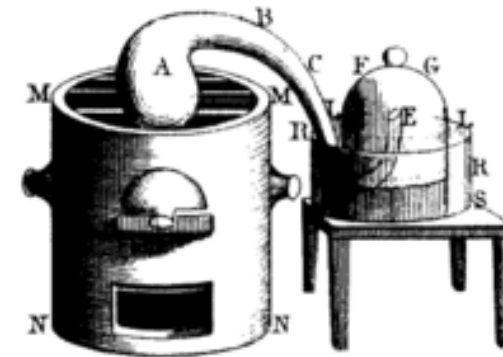
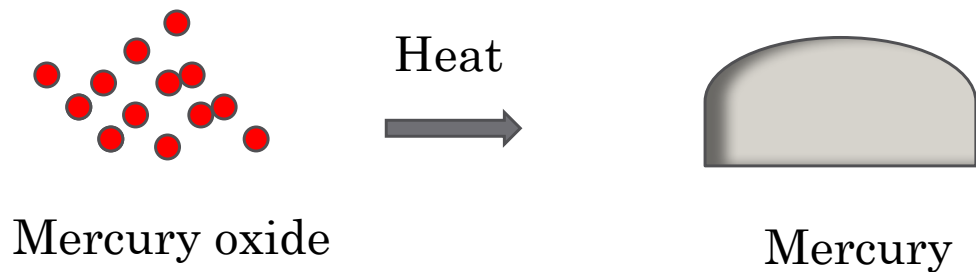


Heating mercury oxide

- Heating mercury oxide (HgO) further gives back mercury and oxygen

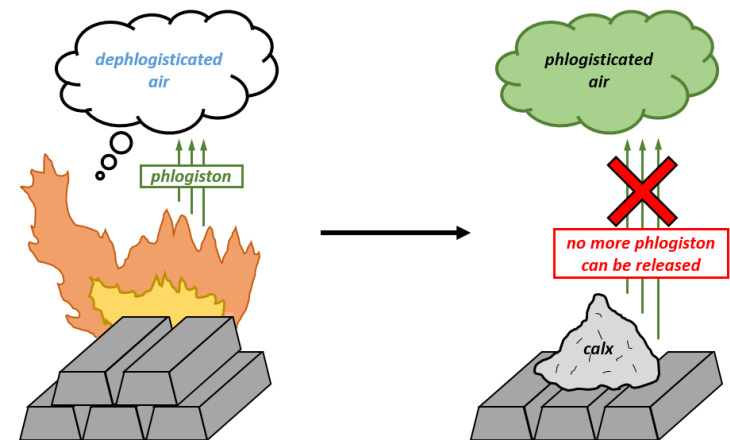
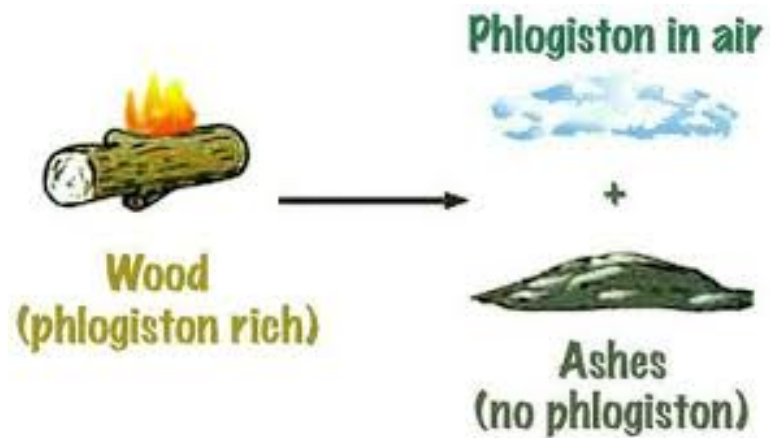


Same volume of air is increased



Phlogiston Theory

- Phlogiston leaves and a decrease in weight is expected

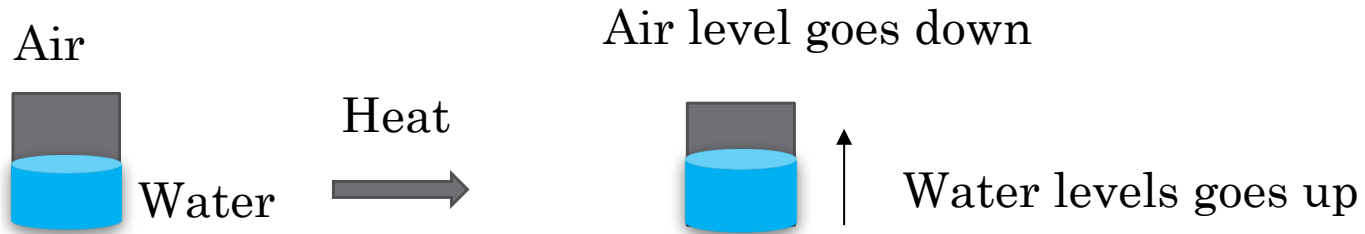


<https://jahschem.wikispaces.com/phlogiston+theory>

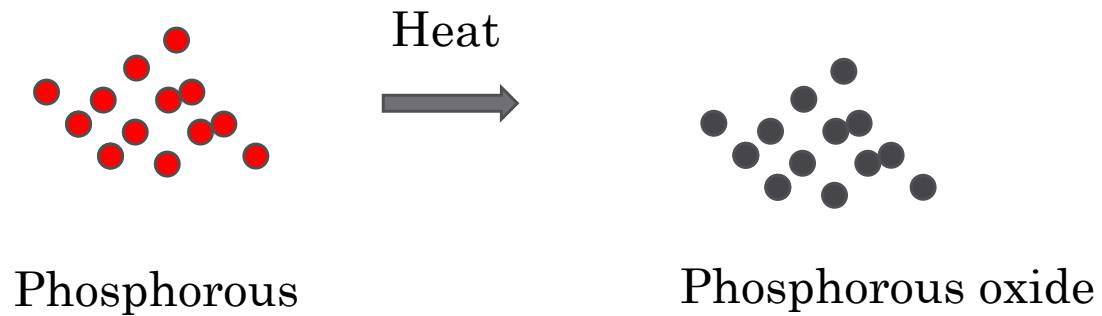
<https://treetownchem.blogspot.com>

Phlogiston Theory

- Phlogiston leaves and a decrease in weight is expected



Volume of air goes down!

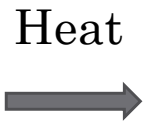


Where does the extra weight go?

240 milligrams



Magnesium



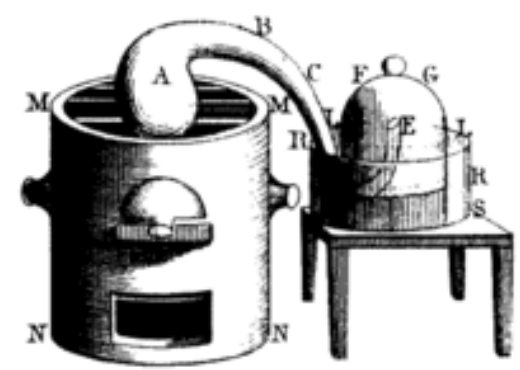
400 milligrams



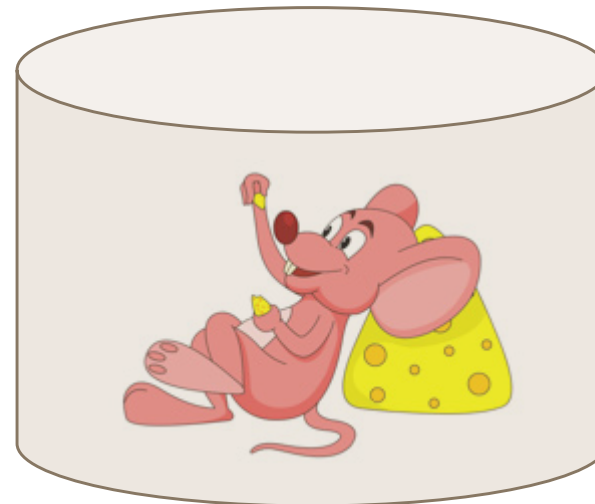
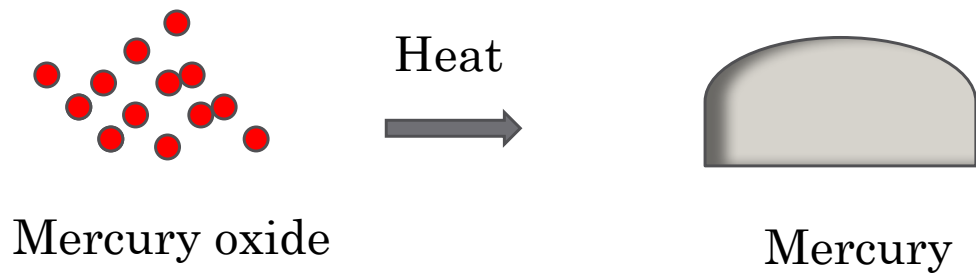
Magnesium oxide

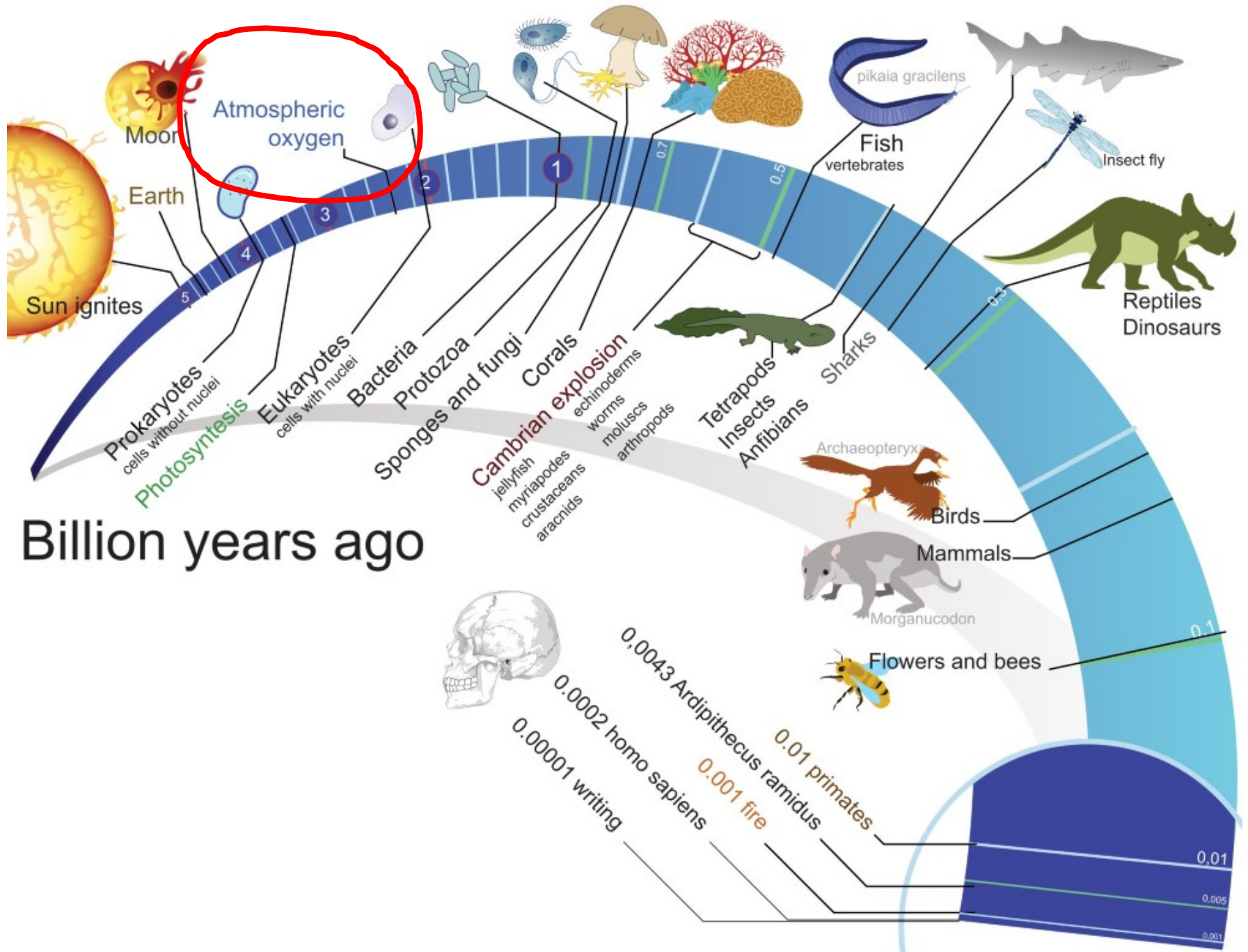
- Similar observations were recorded for sulfur...
- Increase in weight means no “phlogiston” leaves the material!
- Development of the scientific method...
- Quantitative measurements!

Oxygen...



- Heating mercury oxide (HgO) further gives back mercury and oxygen





Billion years ago

Atmospheric oxygen

Moon

Earth

Sun ignites

Prokaryotes
cells without nuclei

Photosynthesis

Eukaryotes
cells with nuclei

Bacteria

Protozoa

Sponges and fungi

Corals

Cambrian explosion
jellyfish
myriapods
crustaceans
arachnids

echinoderms
worms
molluscs
arthropods

Tetrapods
Insects
Anfibians

Sharks

Archaeopteryx

Birds

Mammals

Morganucodon

Flowers and bees

0.01 primates

0.001 fire

0.0001 writing

0.0002 homo sapiens

0.0043 Ardipithecus ramidus

pikaia gracilens

Fish
vertebrates

Insect fly

Reptiles
Dinosaurs

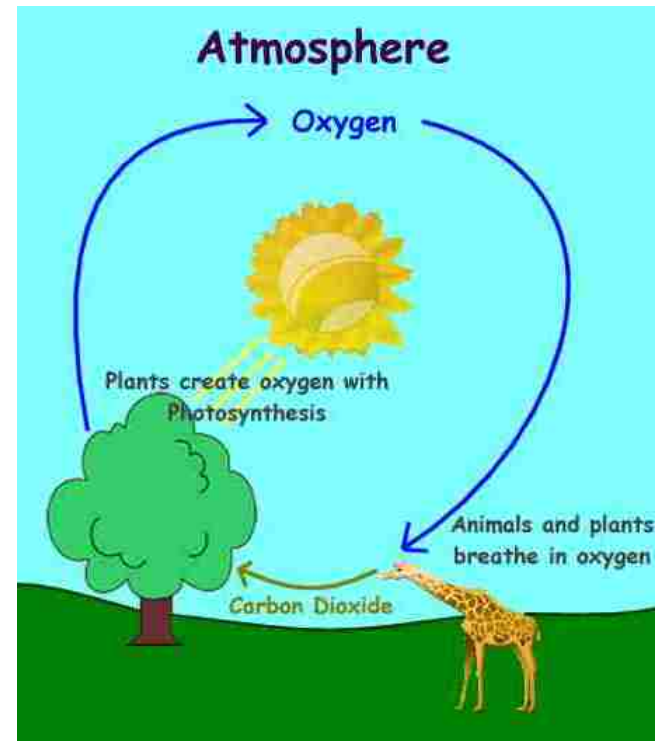
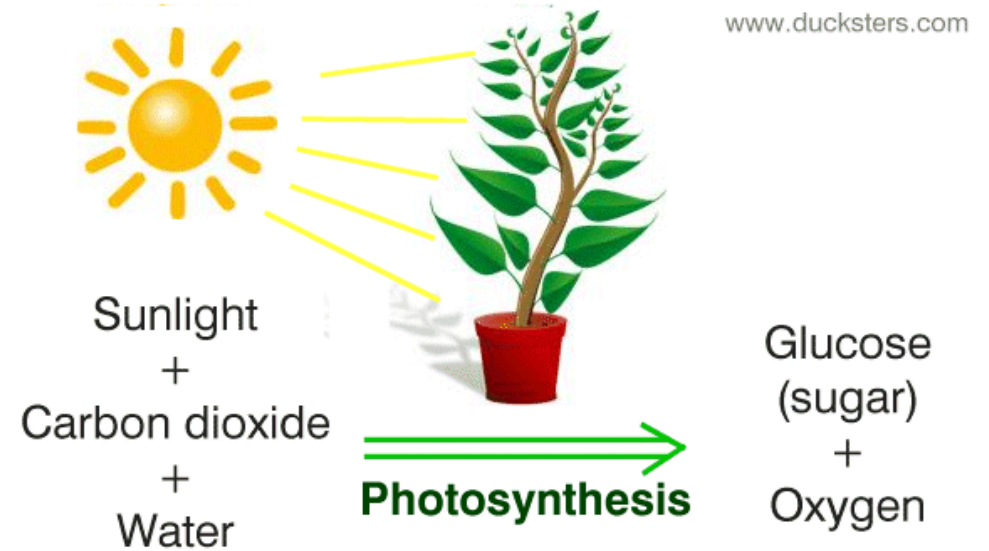
0.01

0.005

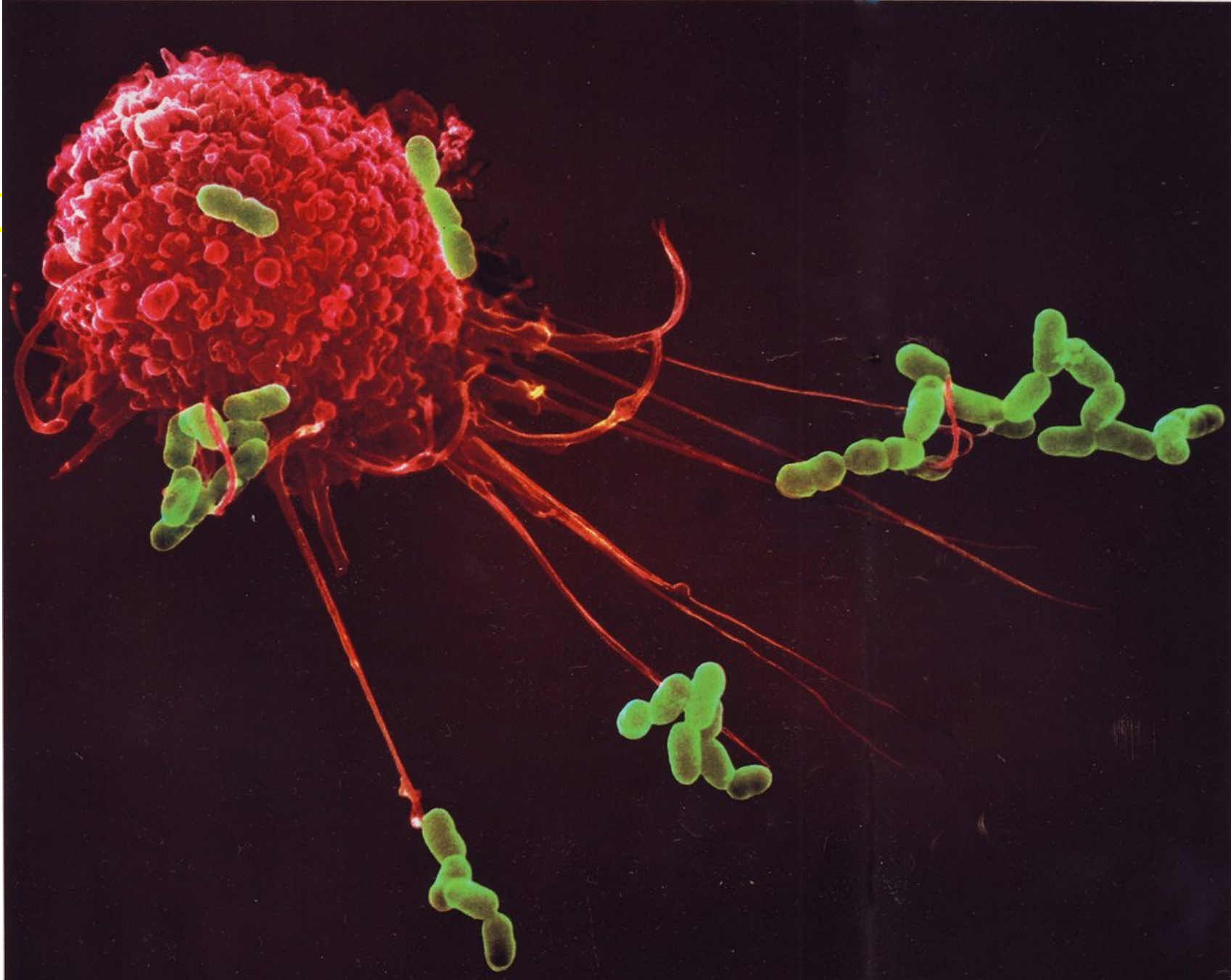
0.001

Earth and Life

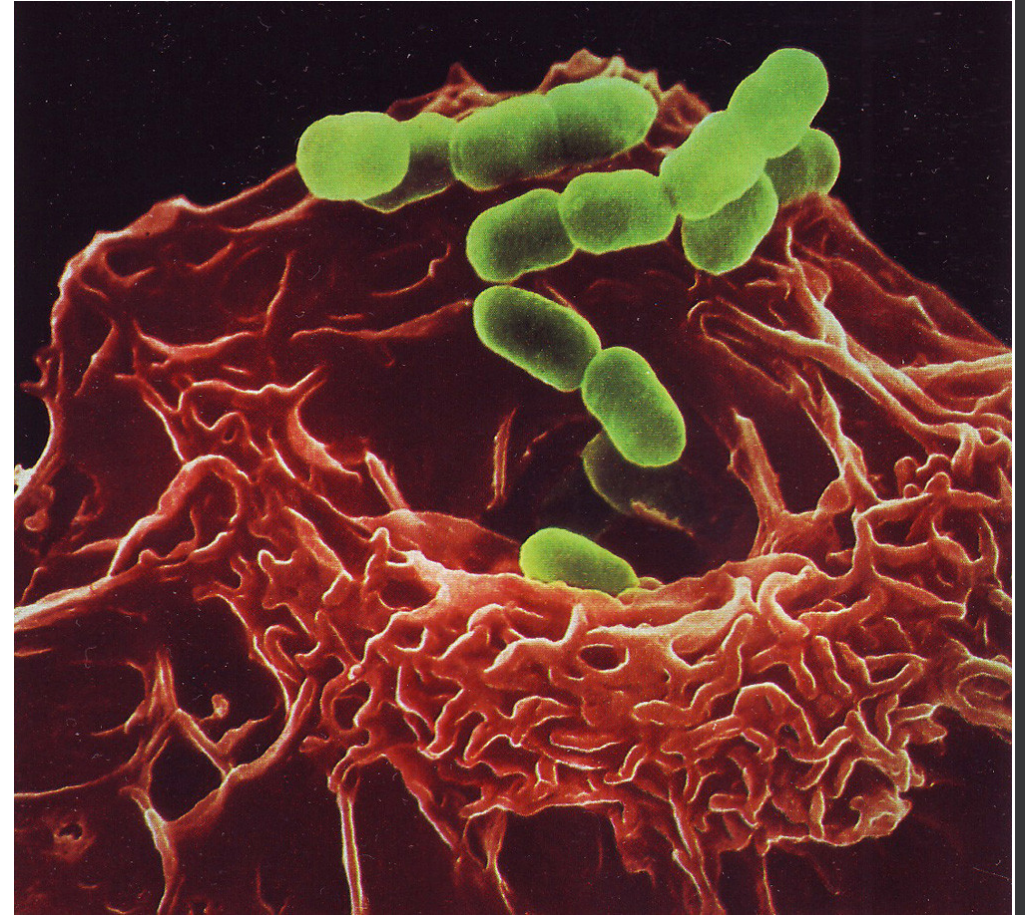
- <https://www.youtube.com/watch?v=sturoUChNo4>
- Earth's atmosphere had primarily nitrogen, some CO₂ and very little or no oxygen
- Cyanobacteria evolved to convert carbon dioxide to oxygen (photosynthesis)
- The oxygen formed is toxic (How? We shall see...)!
- Opportunity to use oxygen-based or aerobic respiration
- Plants use CO₂ to produce oxygen during photosynthesis...



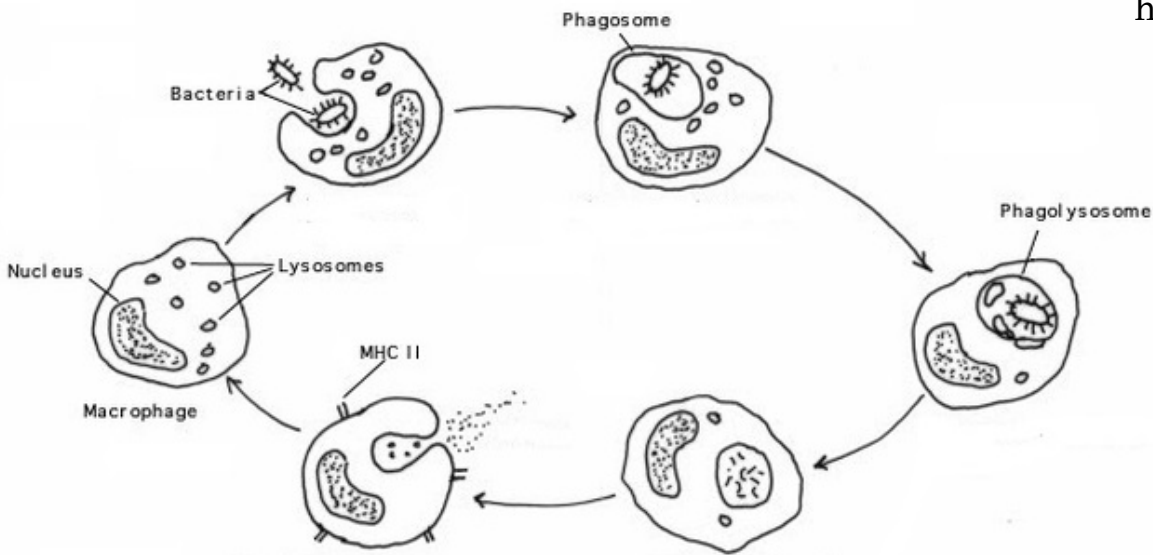
Ox



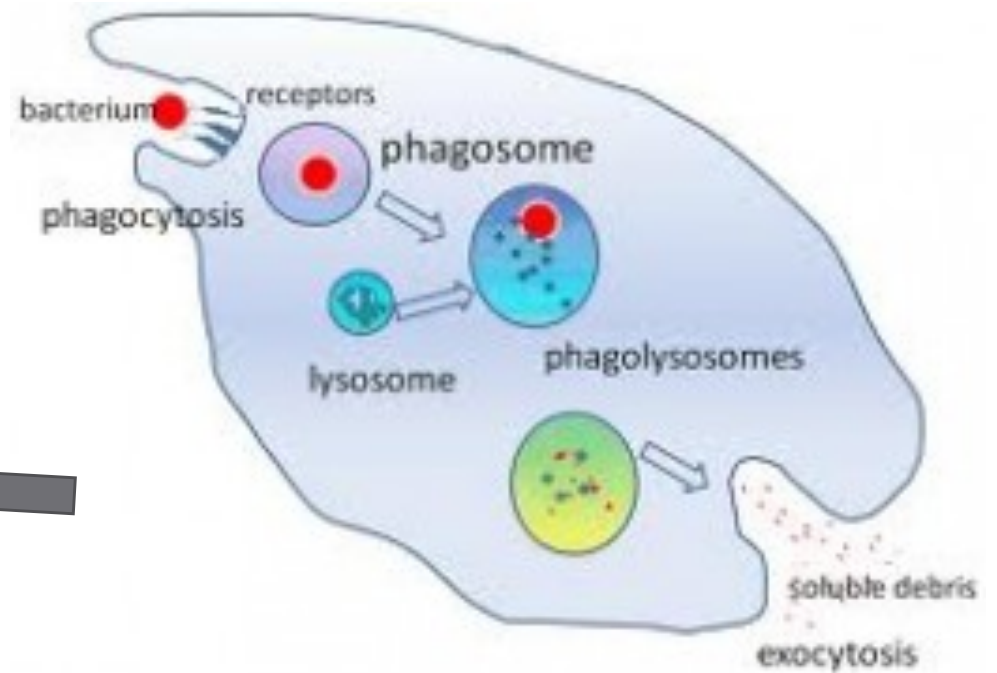
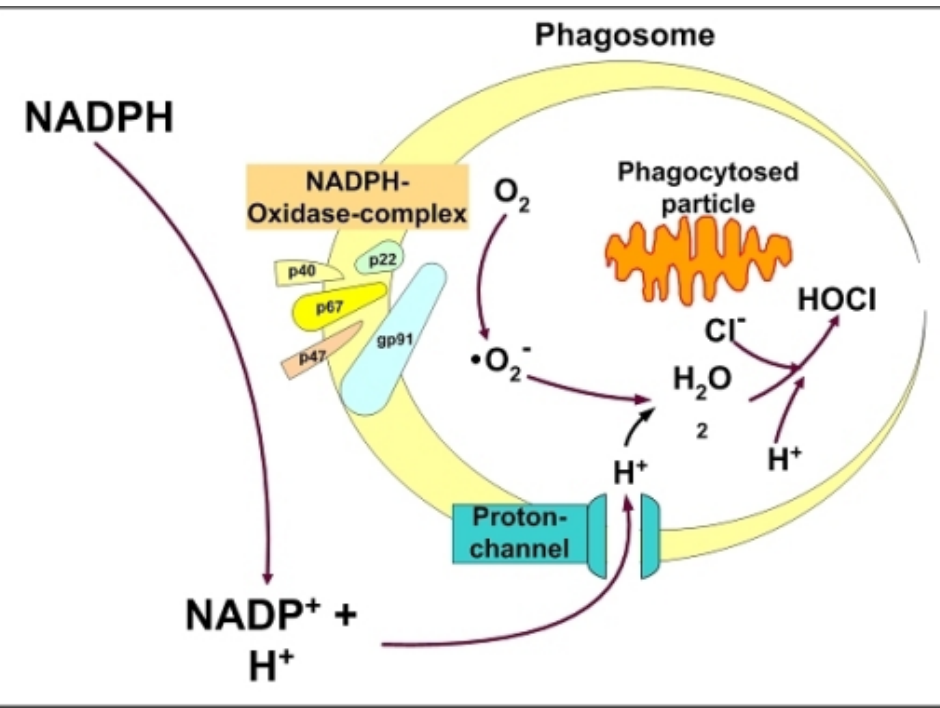
<http://nathantracy.net/wars-inside-you/>



<http://nathantracy.net/wars-inside-you/>



https://openi.nlm.nih.gov/detailedresult.php?img=PMC3199796_CTO-03-02-g-012&req=4



Oxygen has many roles in our life

- Vital to life
- Can be toxic to certain organisms!
- Its discovery was an important step in the development of the scientific method
- Oxygen can be used for cellular defense...
- Many other roles...