

# Introduction to Biology. Lecture 5

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# Outline

## 1 Where we are?

- Very basics of chemistry

## 2 Origin of Earth

- Basics of chemistry

## 3 Floating continents

- Continental drift
- Plate tectonics



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# Where we are?

## Very basics of chemistry



# Very basics of chemistry

- Atoms
  - Protons
  - Neutrons
  - Electrons
- Atomic weight
- Isotopes: how to guess what are they
- Elements and periodic table
- Chemical bonds: ionic, covalent non-polar, covalent polar and hydrogen
- Valence and group
- Molecules
- Molecular weight: how to calculate



# Origin of Earth

## Basics of chemistry



# Acids and bases

- Acids: take out  $\text{H}^+$  (proton), like  
 $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$
- Bases: take out  $\text{OH}^-$  (hydroxyl)  
 $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$





# Molar mass and molar concentration

- Molar mass is a gram equivalent of molecular mass
- For example, molecular mass of salt (NaCl) is  $23 + 35^1 = 58$  Da. We take “Da” out and replace it with “g” (grams). Therefore, 1 mole of salt is 58 g.
- Every mole contains  $6.02214078 \times 10^{23}$  molecules (Avogadro's number)
- Concentration is the density of dissolved substance
- In water solution, 1 M (1 molar) concentration of salt means that in 1 liter of distilled water 58 g of salt was diluted
- If we take half of this water, concentration will still be 1 M whereas amount of diluted salt will decrease twice

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<sup>1</sup> If we accept that atomic mass of chlorine is 35.



# Concentration of protons, and pH and acidity

- If concentration of protons is 0.1 M ( $1 \times 10^{-1}$ , 0.1 g of protons in 1 l of water), this is an extremely acidic solution
- In distilled water, concentration of protons is equal to  $1 \times 10^{-7}$  (0.0000001) M
- This is because water molecules can (rarely) dissociate:  $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$
- pH of distilled water is equal to  $-\log(10^{-7}) = -(-7) = 7$
- pH of the extremely acidic solution (first example) is 1



# Floating continents

## Continental drift

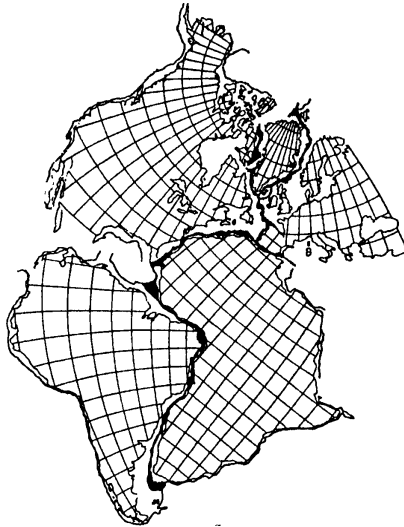


# Continental drift

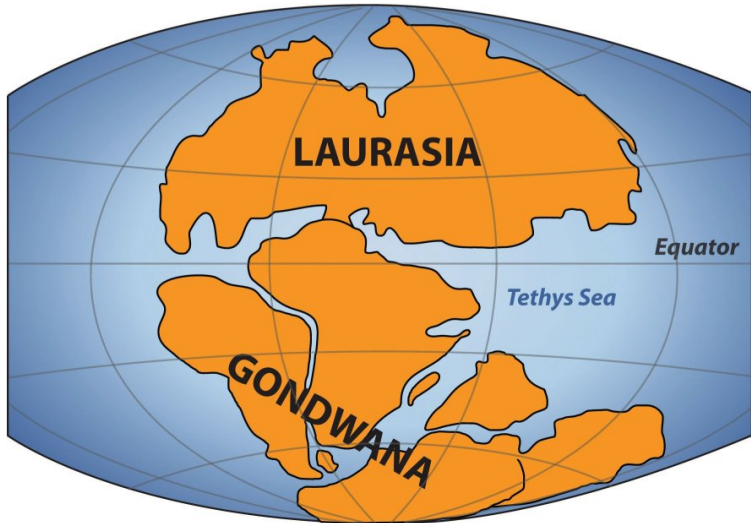
- In 1921, Alfred Wegener invented the idea that South America and Africa were parts of one big continent—Gondwana.
- According to Wegener, in the end of Paleozoic era, there were two big continents—Gondwana and Laurasia separated by Tethys ocean
- Before that, all continents were united in one—Pangaea surrounded by one big ocean.



# One of Vegener's arguments



# Laurasia and Gondwana



# Pangaea



# Floating continents

## Plate tectonics



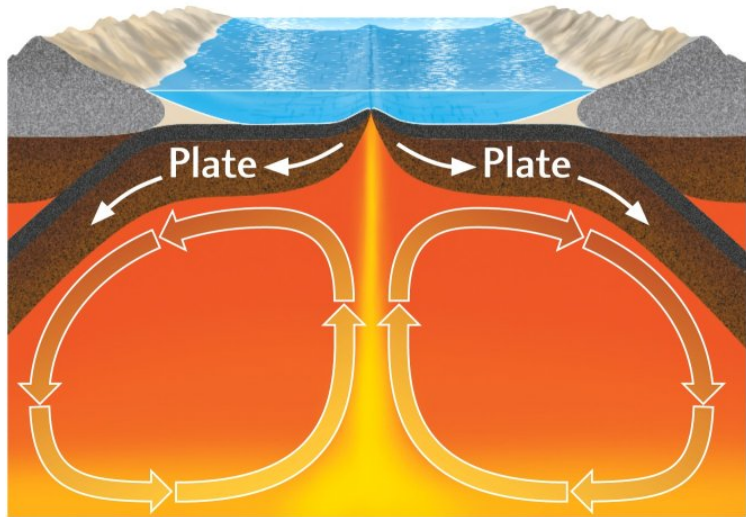


# Mantle convection

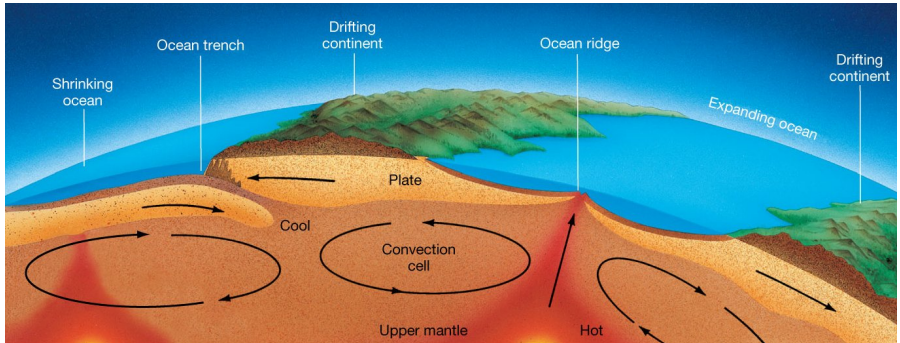
- The driving force of floating continents is a **mantle convection**
- In ocean ridges, new ocean cortex is constantly forming and expanding
- In ocean trenches and continental ridges, different plates are colliding and often forming mountains



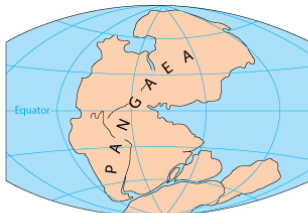
# Mantle convection



# Mantle convection



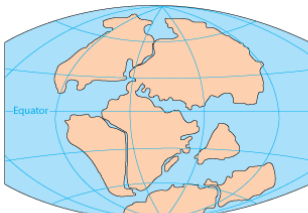
# The result of mantle convection



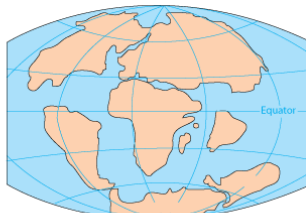
PERMIAN  
250 million years ago



TRIASSIC  
200 million years ago



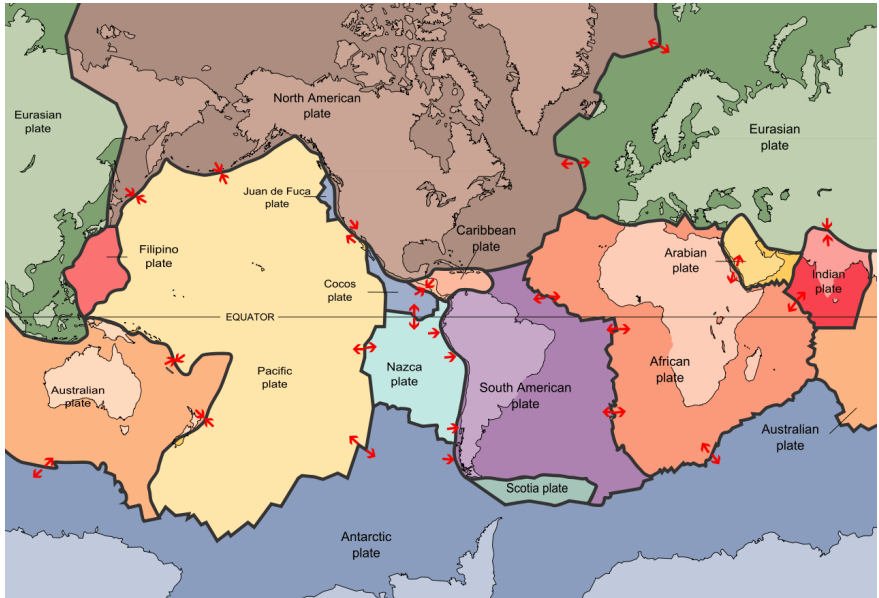
JURASSIC  
145 million years ago



CRETACEOUS  
65 million years ago



# What is going on now

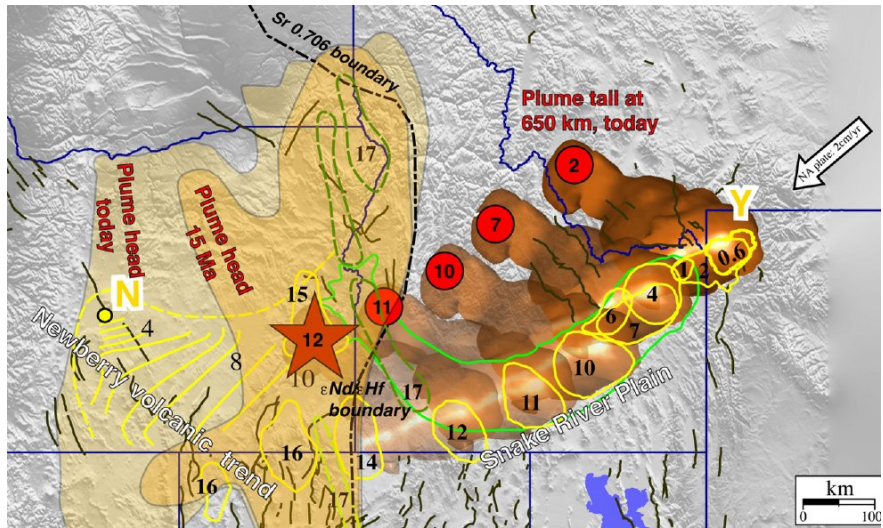


# Two living examples of continental drift on U.S. territory

- Yellowstone hotspot
- Hawaiian hotspot



# Yellowstone hotspot

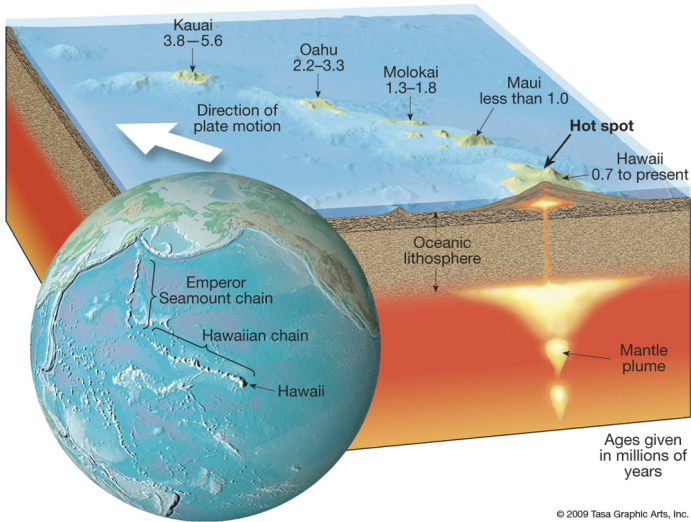


# Hawaiian hotspot (as pictured in “Moana”)





# Hawaiian hotspot (more scientific)



# Summary

- In chemistry, moles are used to make chemical reactions go without problems
- Concentration will not change if we throw away half of liquid
- Continents of Earth are constantly changing their position due to the mantle convection (“plate tectonics”)
- In the past (Permian period) all continents formed super-continent Pangaea, which then broke into Laurasia and Gondwana



# For Further Reading



[Mole. Wikipedia.](#)

[http://en.wikipedia.org/wiki/Mole\\_\(unit\)](http://en.wikipedia.org/wiki/Mole_(unit))



[Plate tectonics.](#)

[http://en.wikipedia.org/wiki/Plate\\_tectonics](http://en.wikipedia.org/wiki/Plate_tectonics)

