

# Introduction to Botany: BIOL 111

## Study guide for Exam 1

Alexey Shipunov

Lectures 1–6

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## Outline

# 1 Course in general

## 1.1 Description

### Course description from catalog

- This course is designed to accommodate one semester of the General Education requirement for non-science majors at Minot State University.
- The course focuses on a comprehensive survey of modern biology with an emphasis on enhancing the science literacy of the college educated student.
- Topics include: cell biology, genetics, evolution by natural selection, systematics, and the impact of human activity on the biosphere.

### My description

- Biology is the largest of all sciences, and develops most rapidly. It is simply impossible to cover **BIOLOGY** in one-semester course.
- I choose a strategy to elucidate the most important biological concepts from the standpoint of the **History of Life**.
- We will go through the major events in this history and learn basic chemistry of life, cell construction, genes and DNA, organization of animal body and other fundamental biological ideas.
- In general, this course is not recommended for science majors

### Instructor

- Dr. Alexey Shipunov
- Office: Moore 229
- Office Hours: Mondays, Wednesdays and Fridays, 11 am to 12 am
- Phone: 858-3116
- E-mail: alexey.shipunov@minotstateu.edu

**Lectures** Mondays, Wednesdays and Fridays, 12:00 am to 12:50 am, Moore 16

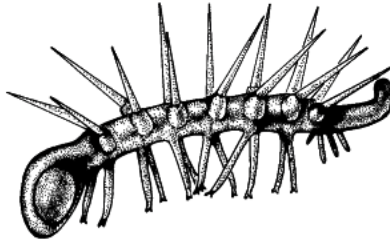
**Laboratories** Mondays and Wednesdays, **Swain 304**

Laboratories will start from September 8!

## Web site

© Shipunov, A. Introduction to Biology [Electronic resource]. 2012—onwards.  
Mode of access: [http://ashipunov.info/shipunov/school/biol\\_111](http://ashipunov.info/shipunov/school/biol_111)

# BIOL 111: Introduction to Biology



### Course materials:

- [Syllabus](#) (PDF, 0.2 Mb)
- [Lecture 1](#) (PDF, 0.5 Mb)
- [Lab manual](#) (PDF, 1.6 Mb)

[Back](#)

[http://ashipunov.info/shipunov/school/biol\\_111](http://ashipunov.info/shipunov/school/biol_111)

Please check it regularly. There will be much more material due course. As a rule, slides of every lecture will be available after this lecture.

## Textbook

None. Instead, for every lecture I will give a list of readings, mostly from



# WIKIPEDIA

## *The Free Encyclopedia*

### 1.2 Grading

#### Exams

- **Five** exams are given during the semester.
- Only **four** best exams contribute to the final grade.
- Missed exams count zero points. There are **no make-up** exams.

#### Absence

Absence from exams or laboratories needs to be announced to the instructor in advance. There are five legitimate reasons for absence:

- A. emergency situations,

- B. attested medical conditions
- C. military duty,
- D. participation in MSU sports events,
- E. dependent sick leave.

If you have a legitimate reason (above) it is possible to come for the lab with different section. Please, however, *do not forget to inform **both** instructors in advance.*

I strongly recommend attending lectures regularly. Lecture contents will be the main source of information required for the exams.

### Points

A total of  $\approx 420$  points can be earned and are distributed as follows (grading points may vary):

**Four best exams** :  $\approx 240$  points

**Laboratories** : 180 points (15 points per lab)

### Grade calculation

- $A \geq 90\%$
- $B \geq 80\%$
- $C \geq 70\%$
- $D \geq 60\%$
- $F < 60\%$

A minimum of one letter grade will be deducted from the grade for academic dishonesty / plagiarism.

### Preparation to exams

- Download go through all lecture slides / study guide
- Read everything what is listed in “For Further Reading” section
- Try not only memorize this stuff, but also understand how described things work

### Exam grades

- I will grade the curve by “trimmed maximum”
- For example, if the maximum results are (in descending order): 67, 63, 61, 61, 61, 60, 60, 60, 60, ... — I will take out “outliers” and set the trimmed maximum (or 100%, or “A”) as **61**.
- Then “B” will start from 54, “C” will start from 48 and so on.

## 1.3 Course schedule

**Tentative course sequence: from past to present**

- Origin of Earth, basic chemistry
- Origin of life, DNA, RNA and proteins
- First cells, structure of cell
- Animals
- Plants
- Reproduction
- Adaptation, rise and fall of dinosaurs
- Current life, humans, and the future evolution

## 2 Intro test

### 2.1 Multiple choice questions

#### Question 1

- 1 Why deciduous plants take off their leaves?
  - A. To prevent freezing
  - B. To prevent drying
  - C. To get rid of poisonous chemicals

#### Question 2

- 2 Where does human digestion process start?
  - A. In the mouth
  - B. In the intestines
  - C. In the stomach

#### Question 3

- 3 Which birds do NOT live in Minot on winter?
  - A. Crows
  - B. Hummingbirds
  - C. Sparrows

#### **Question 4**

4 Home country of watermelon:

- A. Central America
- B. Canada
- C. South Africa

#### **Question 5**

5 Why do insectivorous plants eat insects?

- A. To obtain the lacking mineral resources
- B. To get an addition to their common “menu”
- C. To get rid of herbivores

#### **Question 6**

6 Which insects have no queen?

- A. Bumblebees
- B. Ants
- C. Cockroaches

#### **Question 7**

7 Oak tree is pollinated by:

- A. Wind
- B. Bees
- C. Flies

#### **Question 8**

8 Spider has:

- A. 6 legs
- B. 8 legs
- C. 4 legs

#### **Question 9**

9 Apple flower has:

- A. 5 petals
- B. 4 petals
- C. 3 petals

**Question 10**

10 Frightened man has:

- A. Bigger pupils
- B. Smaller pupils
- C. Normal pupils

**Question 11**

11 Polar bears are not eating penguins because:

- A. Penguins run very fast
- B. They cannot meet
- C. Penguins are poisonous for bears

**Question 12**

12 How many toes are on each of cat's hind legs?

- A. 5
- B. 4
- C. 3

**Question 13**

13 Pineapple is a:

- A. Tree
- B. Shrub
- C. Herb

**Question 14**

14 If somebody has an artery cut on the arm or leg, it is recommended:

- A. Put a tight bandage below the cut
- B. Put a tight bandage above the cut
- C. Do nothing

**Question 15**

15 Which of the following is the most precise statement?

- A. We are breathing to support our life
- B. We are breathing to obtain the energy from food
- C. We are breathing to have enough strength for food consuming



### Question 16

16 Which tree is better to plant in Minot house backyard:

- A. Sycamore
- B. Ash
- C. Yew

### Question 17



17 Moles eat:

- A. Worms
- B. Roots
- C. Frogs

### Question 18

18 Which fish gives birth to the fully developed offspring?

- A. Sturgeon
- B. Shark
- C. Flounder

### Question 19

19 Which human organ lives longer?

- A. Heart
- B. Lungs
- C. Brains

### Question 20

20 Which plant normally has a longer root?

- A. Spruce
- B. Chokecherry
- C. Blueberry

### The key

1B; 2A; 3B; 4C; 5A; 6C; 7A; 8B; 9A; 10A; 11B; 12B;  
13C; 14B; 15B; 16B; 17A; 18B; 19A; 20B

Please calculate a sum (every right answer = 1 virtual point)

### Summary

- Please download syllabus from the Web site ([http://ashipunov.info/shipunov/school/biol\\_111](http://ashipunov.info/shipunov/school/biol_111))
- **Five** exams, best **four** will be counted, **no make-ups**
- Again, no make-ups!
- The course sequence is the history of life on Earth

### References

- [1] Biology. Wikipedia. <http://en.wikipedia.org/wiki/Biology>
- [2] History of Life. Wikipedia. [http://en.wikipedia.org/wiki/History\\_of\\_life](http://en.wikipedia.org/wiki/History_of_life)

### Outline

## 3 Questions and answers

### Interesting in being a note taker?

- Disability Services is looking for a note taker in this class. The individual will be paid for taking notes.
- Interested students who will have **consistent attendance** and take complete and legible notes should contact:
- **Melanie Moore**, Student Health and Development Center: Lower level Lura Manor (must enter through South Door facing University Ave) or call 858-**4233**

### 3.1 Comments to introductory test

#### Question 1

- 1 Why deciduous plants take off their leaves?
  - A. To prevent freezing
  - B. **To prevent drying**
  - C. To get rid of poisonous chemicals

#### Question 2

- 2 Where does human digestion process start?
  - A. **In the mouth**
  - B. In the intestines
  - C. In the stomach

*Amylase and lipase*

#### Question 3

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#### Question 4

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  - C. To get rid of herbivores



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- B. Ants
- C. **Cockroaches**





*Bumblebees*

**Question 7**

7 Oak tree is pollinated by:

- A. **Wind**
- B. Bees
- C. Flies



*Oak flowers*

### Question 8

8 Spider has:

- A. 6 legs
- B. **8 legs**
- C. 4 legs

### Question 9

9 Apple flower has:

- A. **5 petals**



B. 4 petals

C. 3 petals

### Question 10

10 Frightened man has:

A. **Bigger pupils**

B. Smaller pupils

C. Normal pupils



### Question 11

11 Polar bears are not eating penguins because:

A. Penguins run very fast

B. **They cannot meet**

C. Penguins are poisonous for bears



 POLAR BEAR DISTRIBUTION (approx.)

12 How many toes are on each of cat's hind legs?

- A. 5
- B. 4
- C. 3



### Question 13

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- A. Tree
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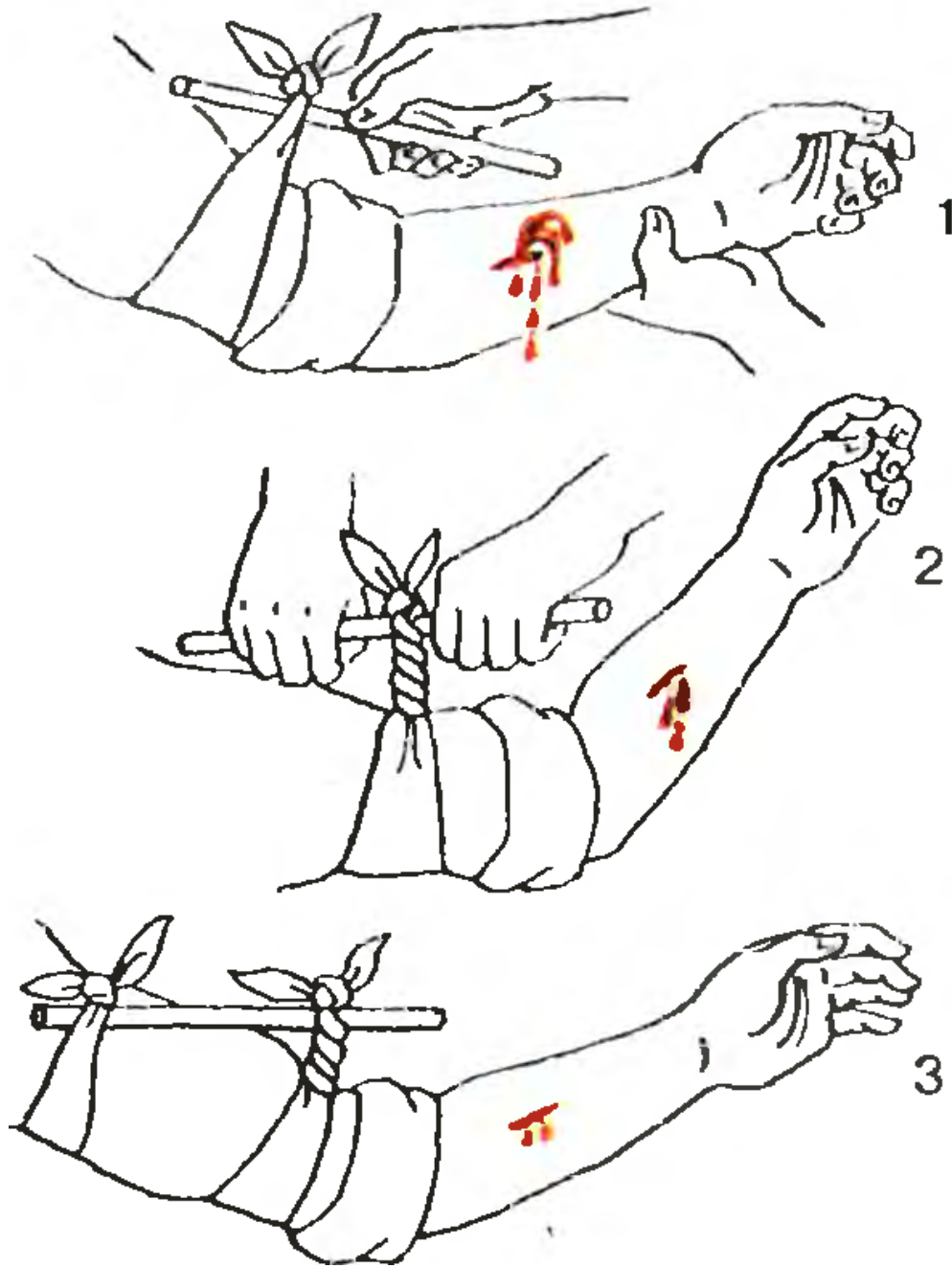




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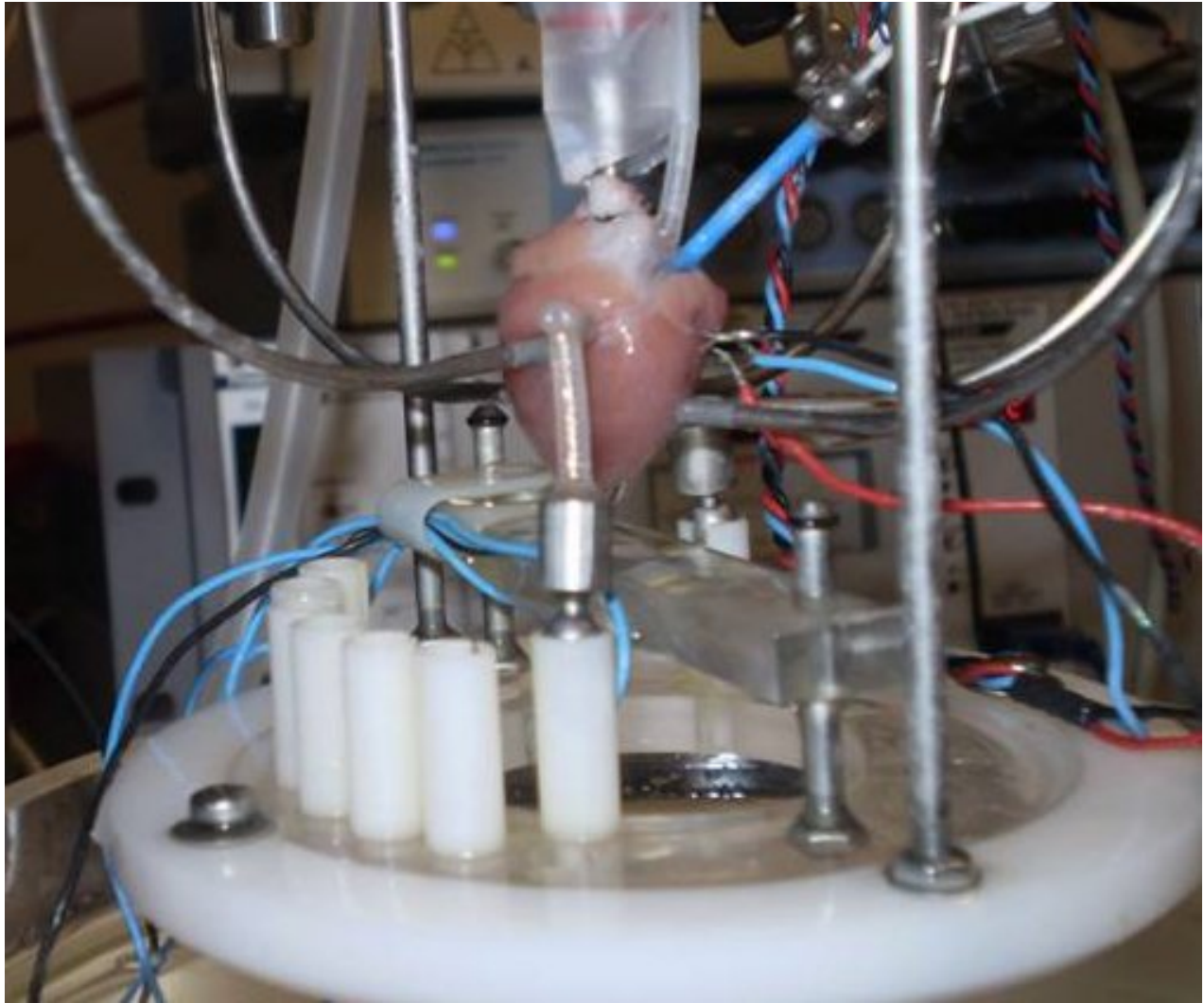




### Question 19

19 Which human organ lives longer?

- A. **Heart**
- B. Lungs
- C. Brains



### Question 20

20 Which plant normally has a longer root?

- A. Spruce
- B. **Chokecherry**
- C. Blueberry





*Fallen*

*spruce tree*

## 4 Age and time. Basic principles

### 4.1 Geological time

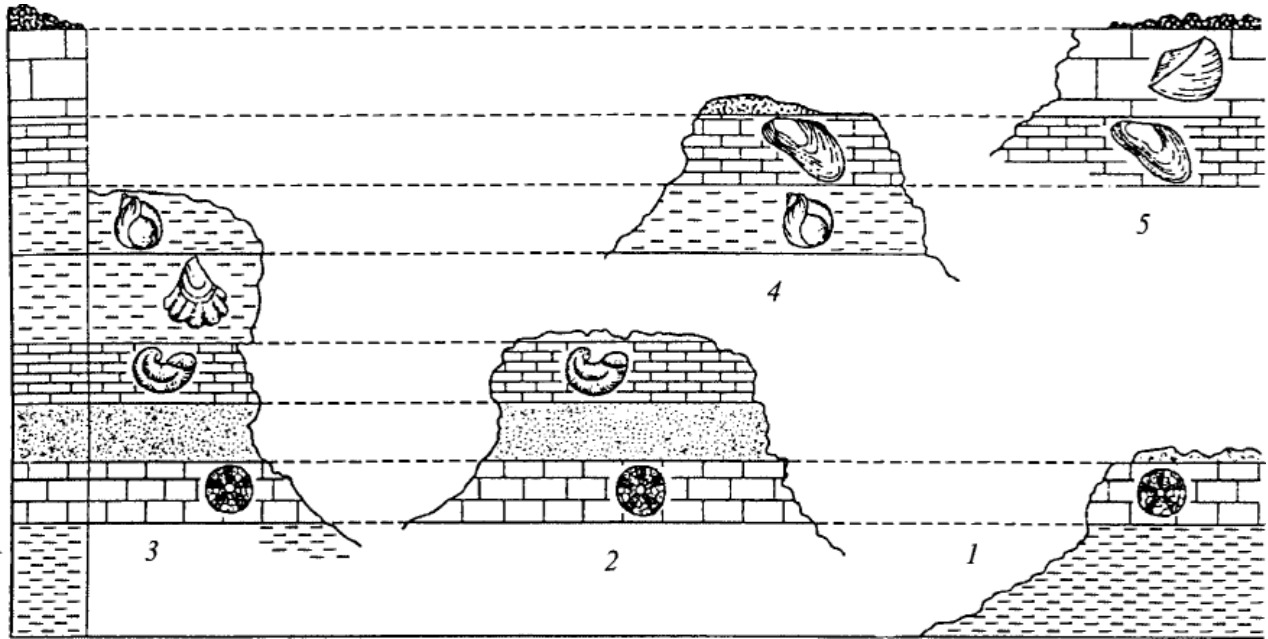
#### First attempts to calculate age of Earth (1830–1850)

- Helmholtz calculated that if Sun is shrinking to obtain the energy, then the age of Earth should not exceed 18 My (millions of years, 18,000,000 years)
- Lyell calculated that if the **speed of sedimentation was the same in the past**, then age of Earth should be approximately 200 My

#### Stratigraphy

- Upper layers are younger than lower
- Two layers contained similar species of fossils have the same time of origin

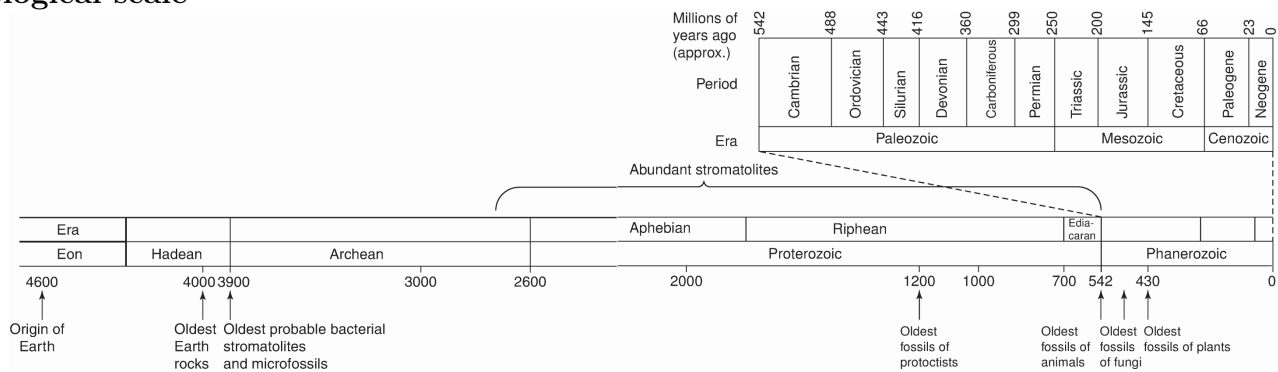
#### How stratigraphy works



## Use of radioactivity

- In 1896, Becquerel discovered **radioactivity**. It was found that some atoms are constantly breaking into smaller ones, sometimes with very slow speed
- Consequently, it is possible to calculate the age of mineral from the concentration of radioactive elements

## Geological scale



## 4.2 Some basic principles

### Principle of actuality

- Charles Lyell (1830)
- “The present is the key to the past”

### Occam's razor

- Father William of Ockham (ca. 1300)
- “Plurality must never be posited without necessity”

## Science as falsification

- Karl Popper (1963)
- “If something cannot be proved wrong, then it is meaningless”

## Summary

- Geological time is calculated on the basis of both relative (stratigraphy) and absolute (radioactivity) methods
- Science is based on the principles of actuality, falsification, Occam’s razor, and hypothesis testing

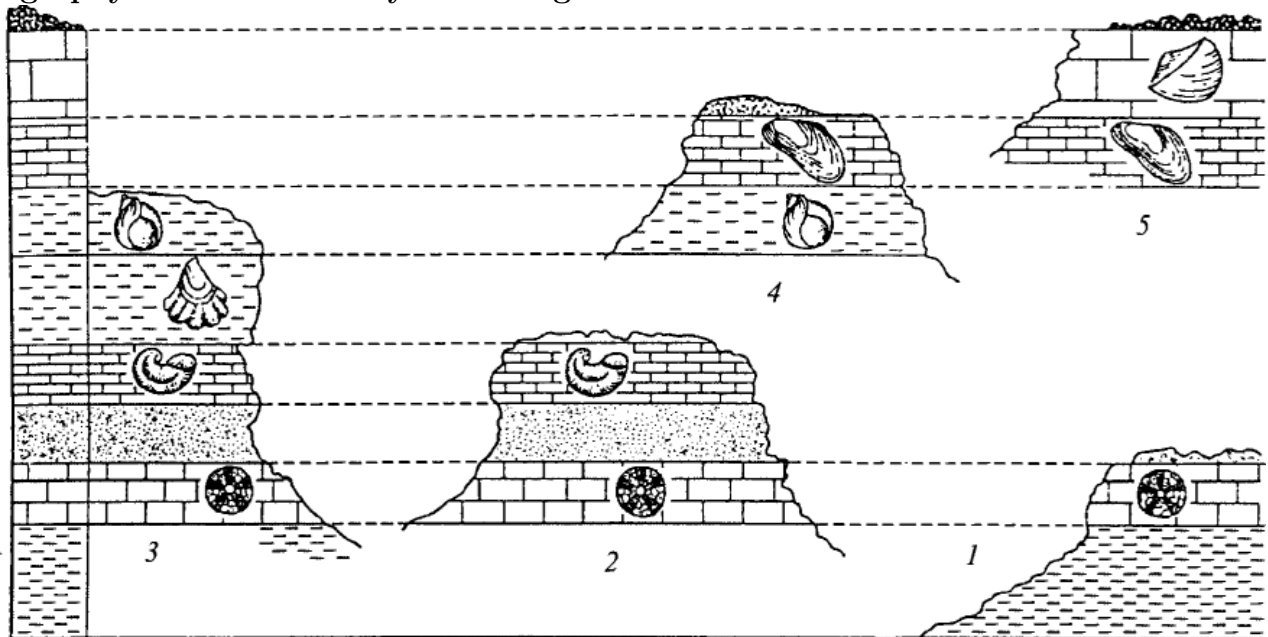
## References

- [1] Biology. Wikipedia. <http://en.wikipedia.org/wiki/Biology>
- [2] History of Life. Wikipedia. [http://en.wikipedia.org/wiki/History\\_of\\_life](http://en.wikipedia.org/wiki/History_of_life)

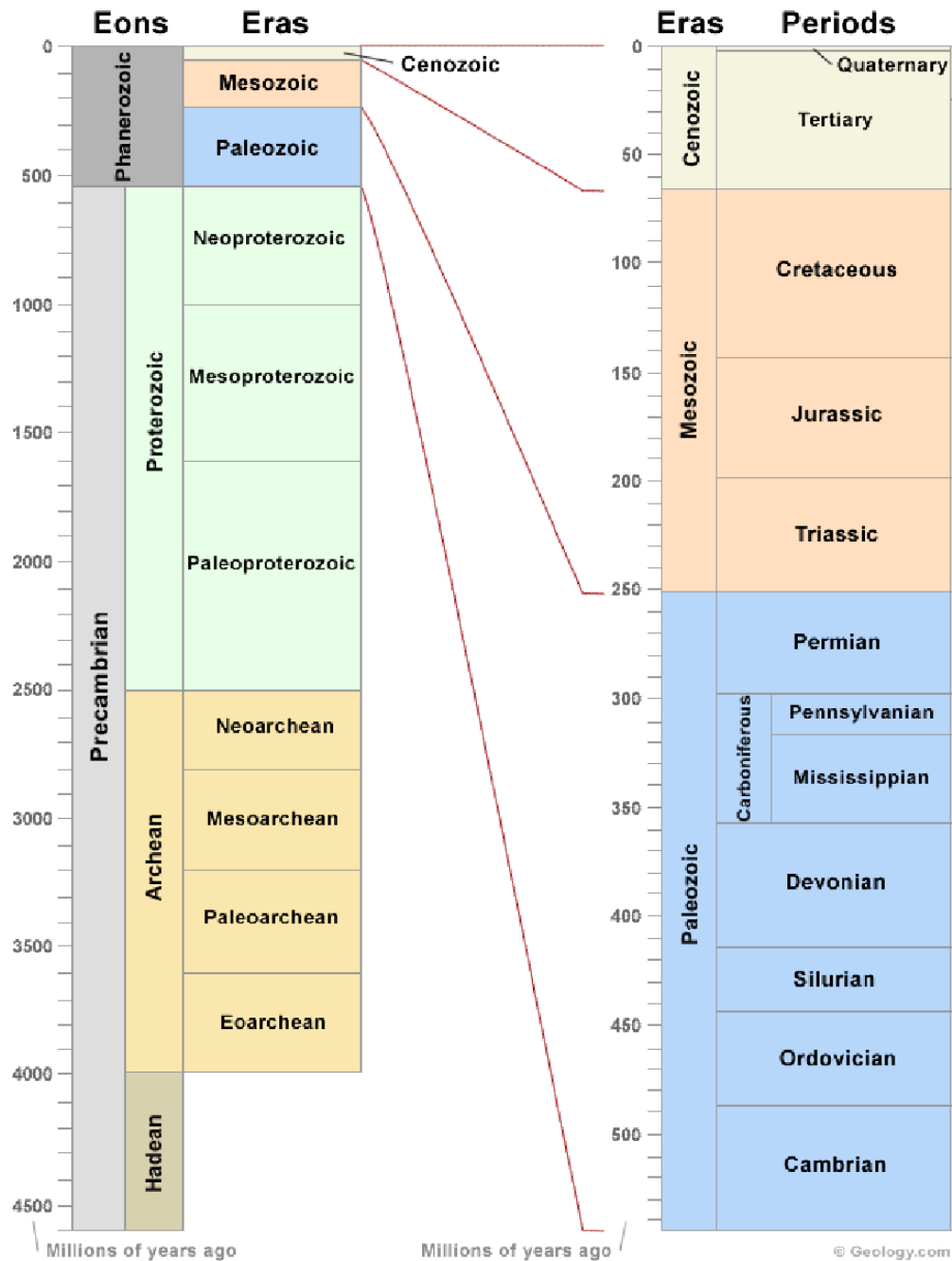
## Outline

# 5 Where we are?

## Stratigraphy and radioactivity works together



## Geological scale (variant 2)



## 5.1 Basic principles of science

### Principle of actuality

- Charles Lyell (1830)
- “The present is the key to the past”

### Occam’s razor

- Father William of Ockham (ca. 1300)
- “Plurality must never be posited without necessity”

## Science as falsification

- Karl Popper (1963)
- “If something cannot be proved wrong, then it is meaningless”

### Example of non-falsifiable hypothesis: Russel’s teapot

... If I were to suggest that between the Earth and Mars there is a china teapot revolving about the sun in an elliptical orbit, nobody would be able to disprove my assertion provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes.

(Bertrand Russel, 1952)



## Null and alternative hypotheses

- Ronald Fisher (1935)
- Null: nothing happened; alternative: something happened
- Normally, we are able only to reject one of them and therefore **fail-to-reject** (not “support”!) the other

## Basic science principles

- Actuality
- Occam’s razor
- Falsification
- Hypothesis testing



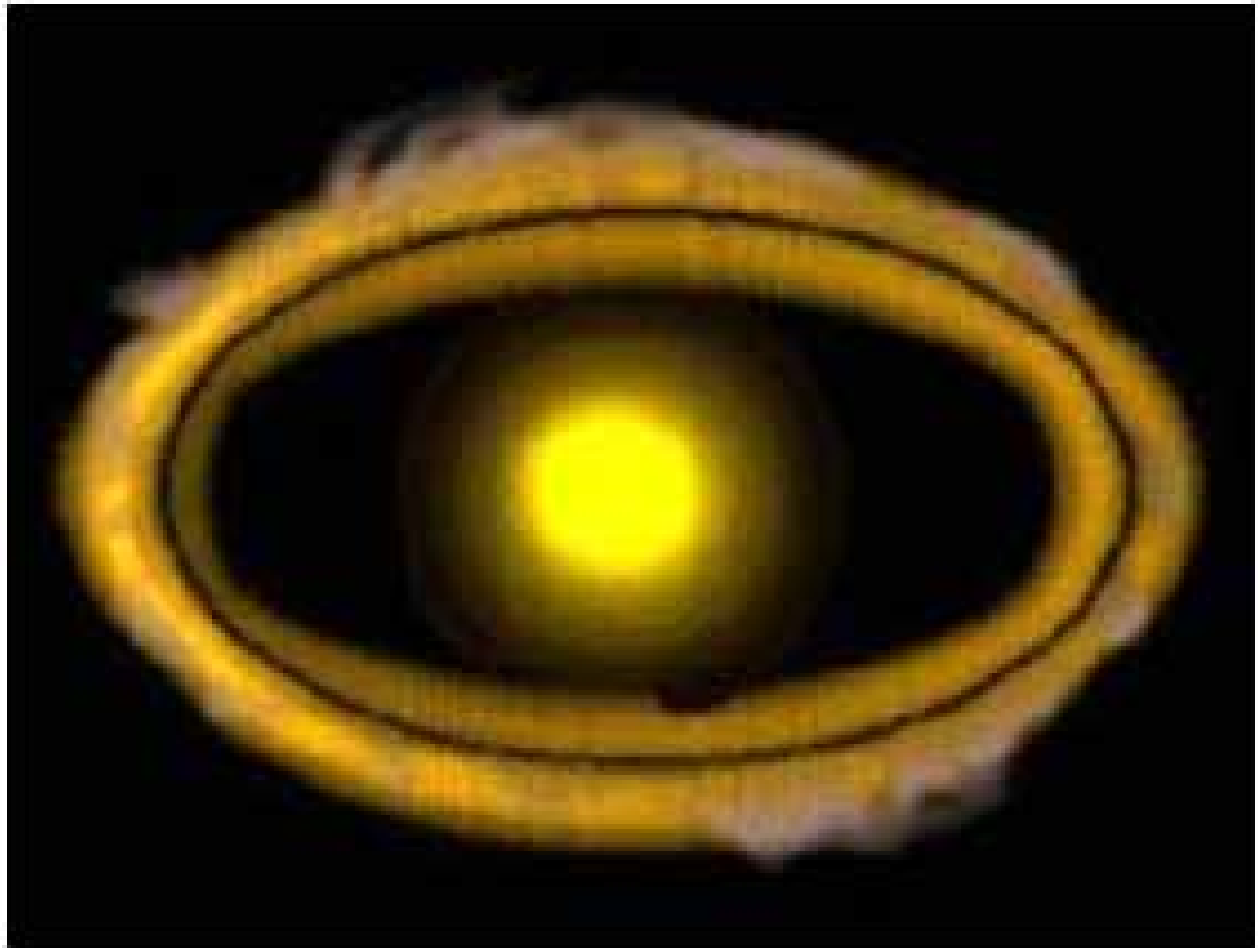
## 6 Origin of Earth. Basic Chemistry

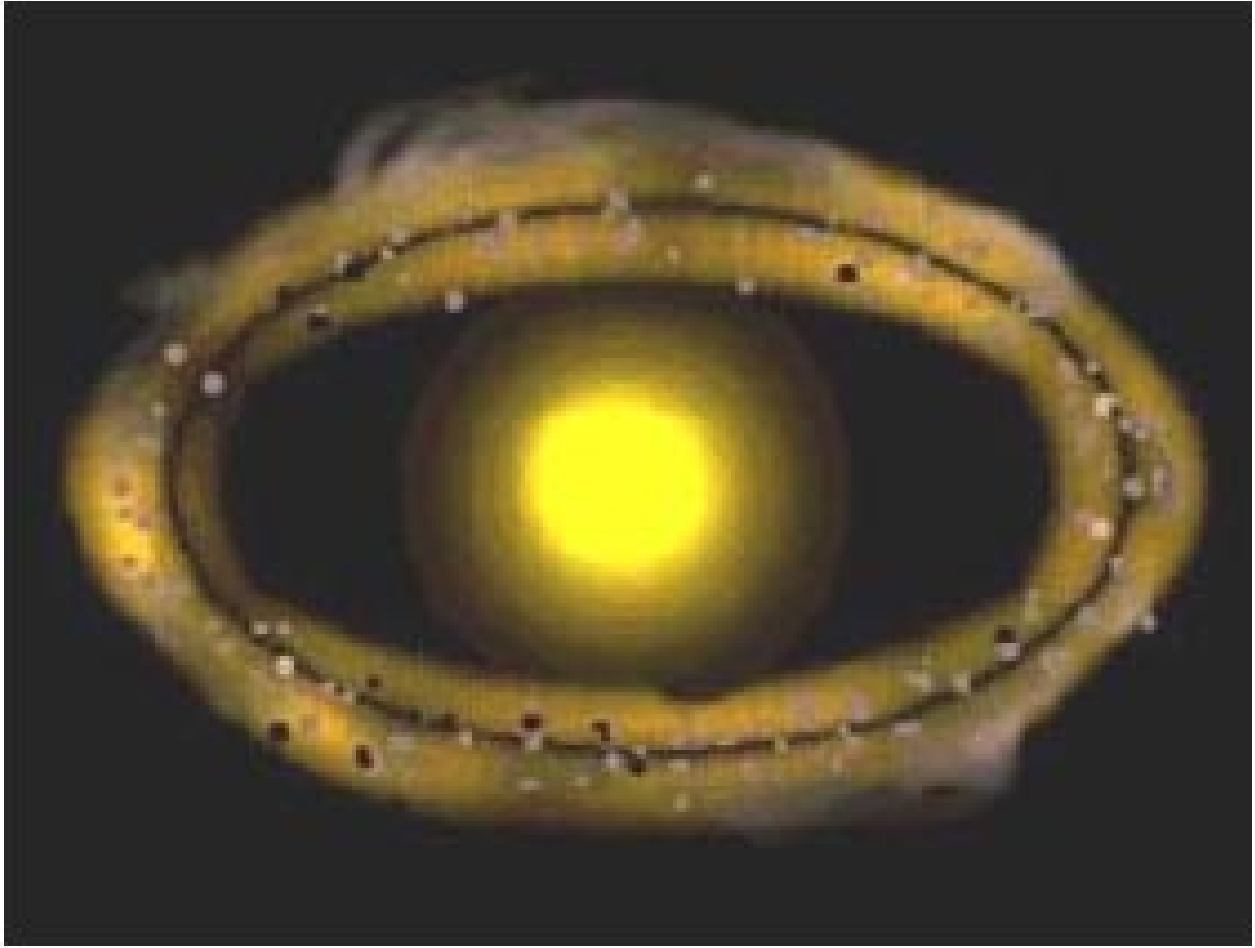
### 6.1 Origin of Earth

Nebula theory: cold Earth

- Pierre-Simon Laplace (1796): Earth originated from a “dust cloud”
- When cloud started to rotate around the Sun, the differentiation into planets started

Nebula: first and second steps





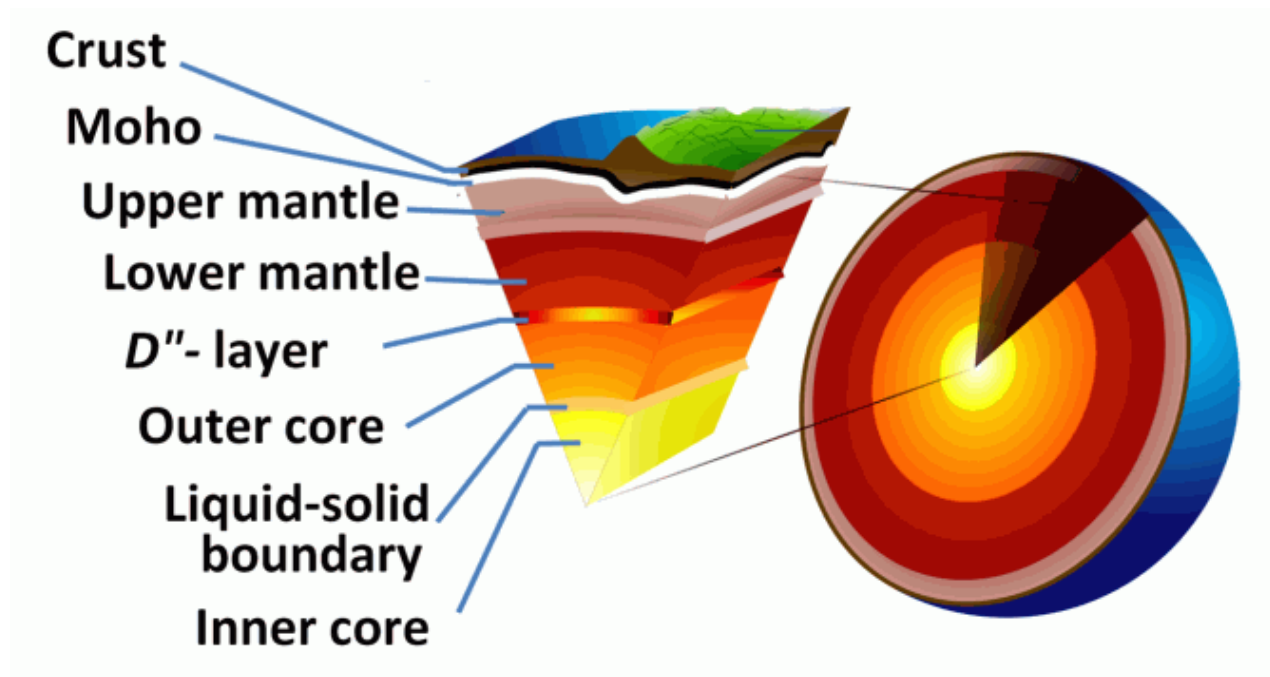
### **Heating: differentiation of depths**

- “Heavy” elements went to the Earth center, light elements—to the surface
- The energy of this movings came out as warmth, and Earth melted (partly)

### **Structure of Earth**

- Now, Earth is spheric drop of extremely viscous and heavy “liquid”
- This drop is structured into several layers. Most important are: crust, mantle and core.

### **The section of Earth**



### Atmosphere and hydrosphere

- The differentiation of Earth body finally resulted in developing of lighter gas layer on the surface (primary atmosphere), initially very thin and relatively cold ( $\approx 15^{\circ}\text{C}$ )
- Therefore, water vapor were condensed into primary ocean (primary hydrosphere)

### Chemistry of atmosphere and hydrosphere

- According to the principle of actuality, it should be close to today's volcanic gases
- 15% of  $\text{CO}_2$ , plus  $\text{CH}_4$  (methane),  $\text{NH}_3$  (ammonia),  $\text{H}_2\text{S}$ ,  $\text{SO}_2$  and different "acidic smokes" like  $\text{HCl}$

## 6.2 Very basics of chemistry

### Very basics of chemistry

- Atoms
  - Protons
  - Neutrons
  - Electrons
- Atomic weight
- Isotopes
- Elements and periodic table
- Chemical bonds



- Valence
- Molecules
- Molecular weight

## Summary

- Geological time is calculated on the basis of both relative (stratigraphy) and absolute (radioactivity) methods
- Science is based on the principles of actuality, falsification, Occam's razor, and hypothesis testing

## References

- [1] Structure of the Earth. Wikipedia. [http://en.wikipedia.org/wiki/Structure\\_of\\_the\\_Earth](http://en.wikipedia.org/wiki/Structure_of_the_Earth)
- [2] Atom. Wikipedia. <http://en.wikipedia.org/wiki/Atom> (until "Identification").

## Outline

# 7 Where we are?

## Very basics of chemistry

- Atoms
  - Protons
  - Neutrons
  - Electrons
- Atomic weight
- **Isotopes**
- Elements and periodic table
- Chemical bonds
- Valence and group
- Molecules
- Molecular weight

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## 8 Origin of Earth. Basics of chemistry

### 8.1 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 ( $\text{NaCl}$ ) is  $23 + 35^1 = 58 \text{ Da}$ . 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, colcentration will still be 1 M whereas amount of diluted salt will decrease twice

<sup>1</sup>If we accept that atomic mass of chlorine in 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

## Summary

- In chemistry, moles are using to make chemical reactions go without problems
- Concentration will not change if we throw away half of liquid

## References

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

## Outline

# 9 Where we are?

## Chemical terms

- Atoms
  - Protons
  - Neutrons
  - Electrons
- Atomic weight
- Isotopes
- Elements and periodic table
- Molecules and molecular weight
- Chemical bonds, valence and group
- Mole
- Molar concentration
- Acids and bases, pH

## Chemistry basics (2)

- pH of distilled water is equal to  $-\log(10^{-7}) = -(-7) = 7$
- Molar mass is a gram equivalent of molecular mass
- For example, molecular mass of salt (NaCl) is  $23 + 35 = 58$ . Therefore, 1 mole of salt is 58 g
- Every mole contains  $6.02214078 \times 10^{23}$  molecules (Avogadro's number)
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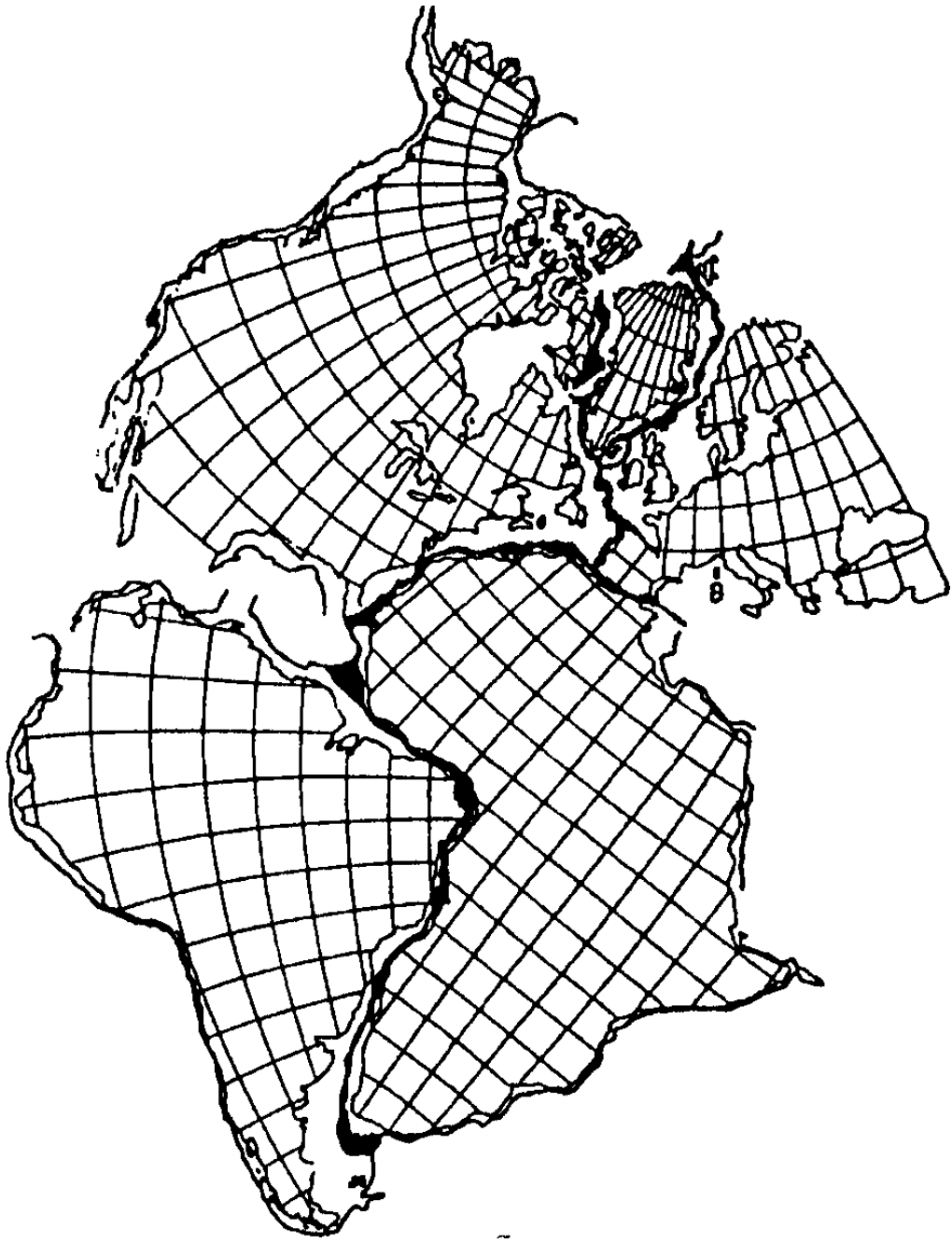
## 10 Floating continents

### 10.1 Continental drift

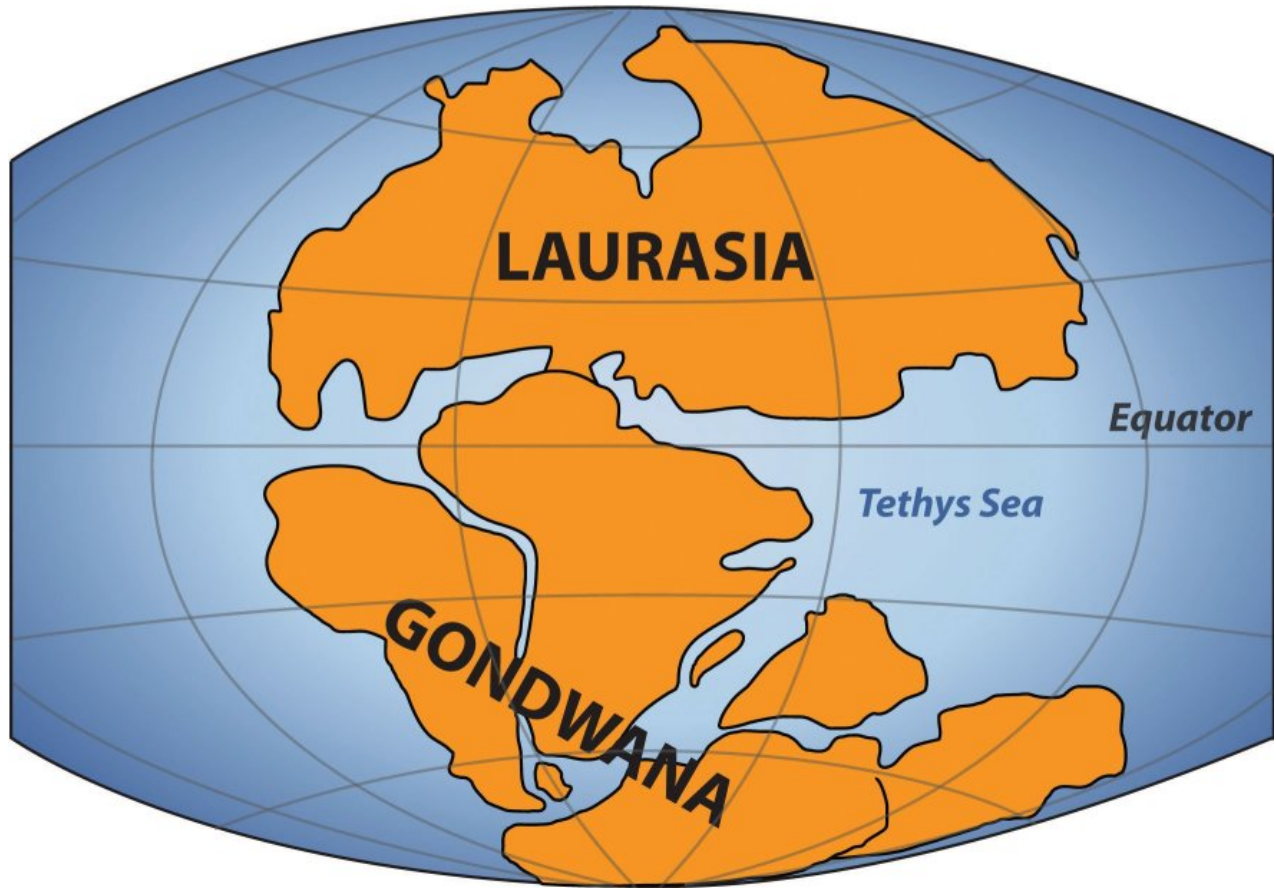
#### Continental drift

- 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 Wegener's arguments



Laurasia and Gondwana



Pangaea

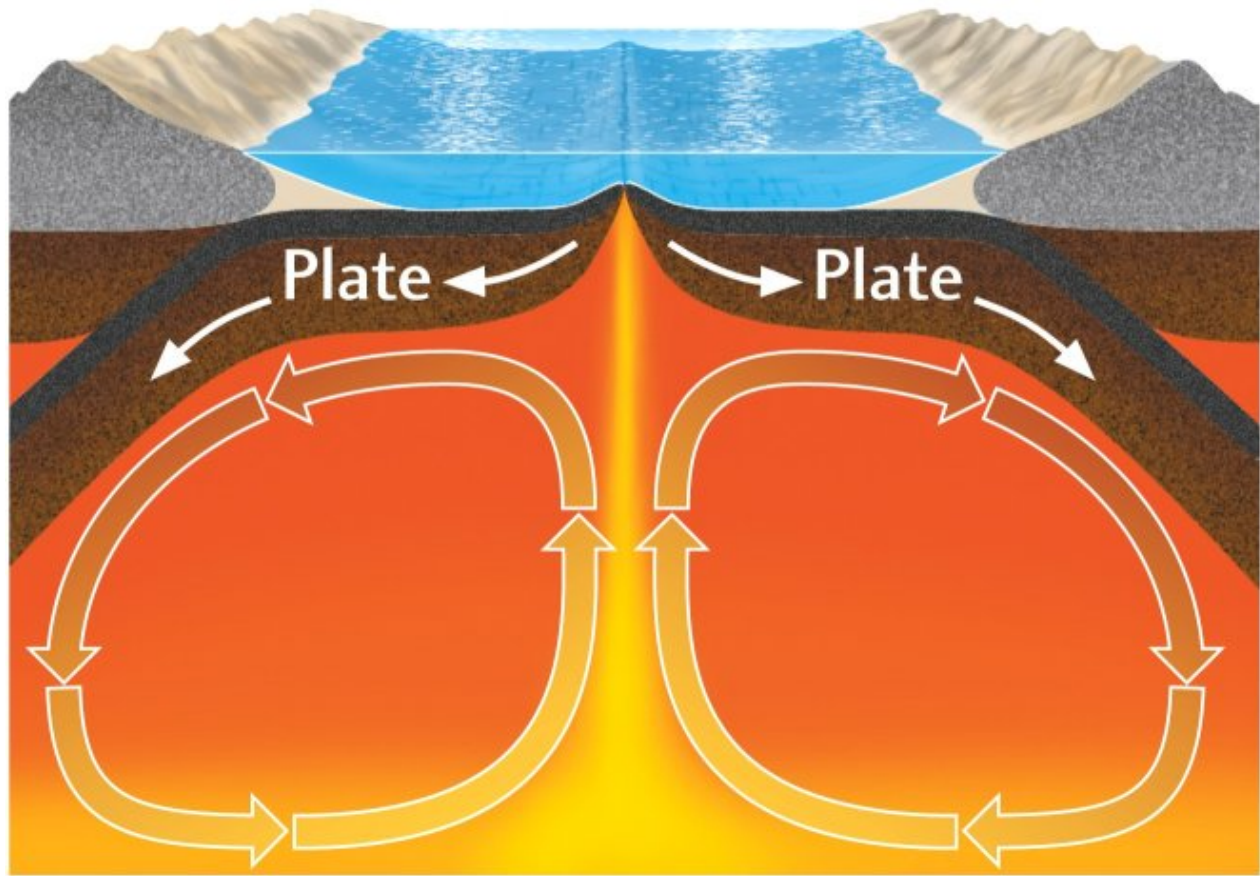


## 10.2 Plate tectonics

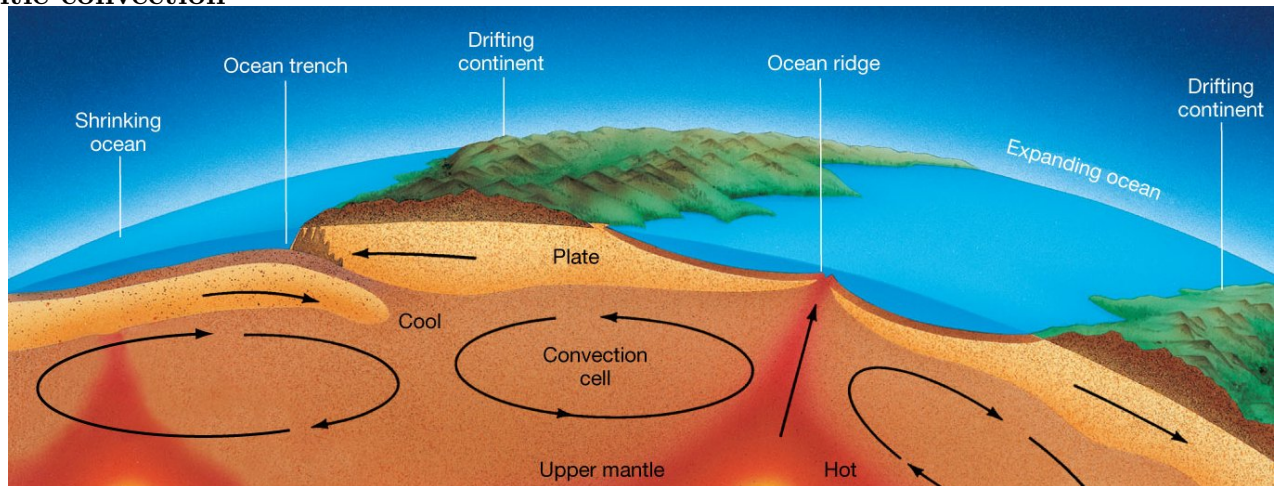
### Mantle convection

- 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

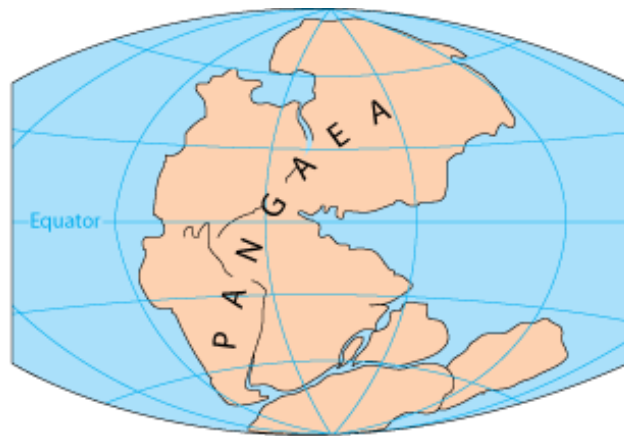


## Mantle convection



## The result of mantle convection

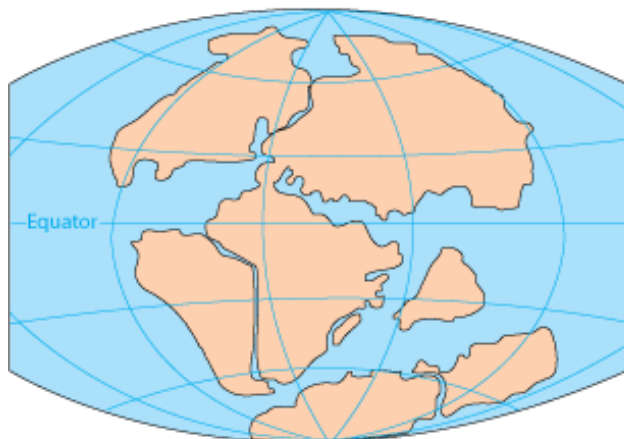




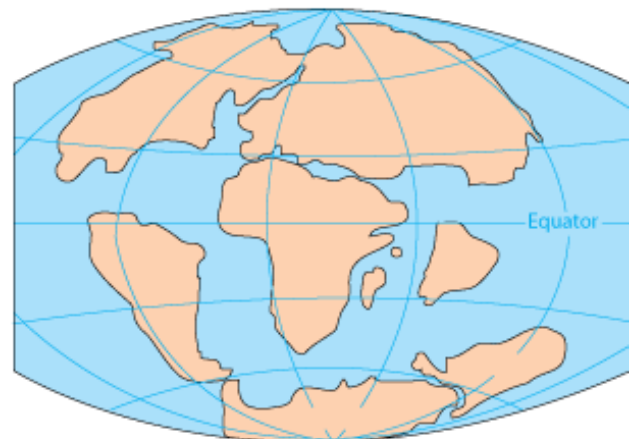
PERMIAN  
250 million years ago



TRIASSIC  
200 million years ago

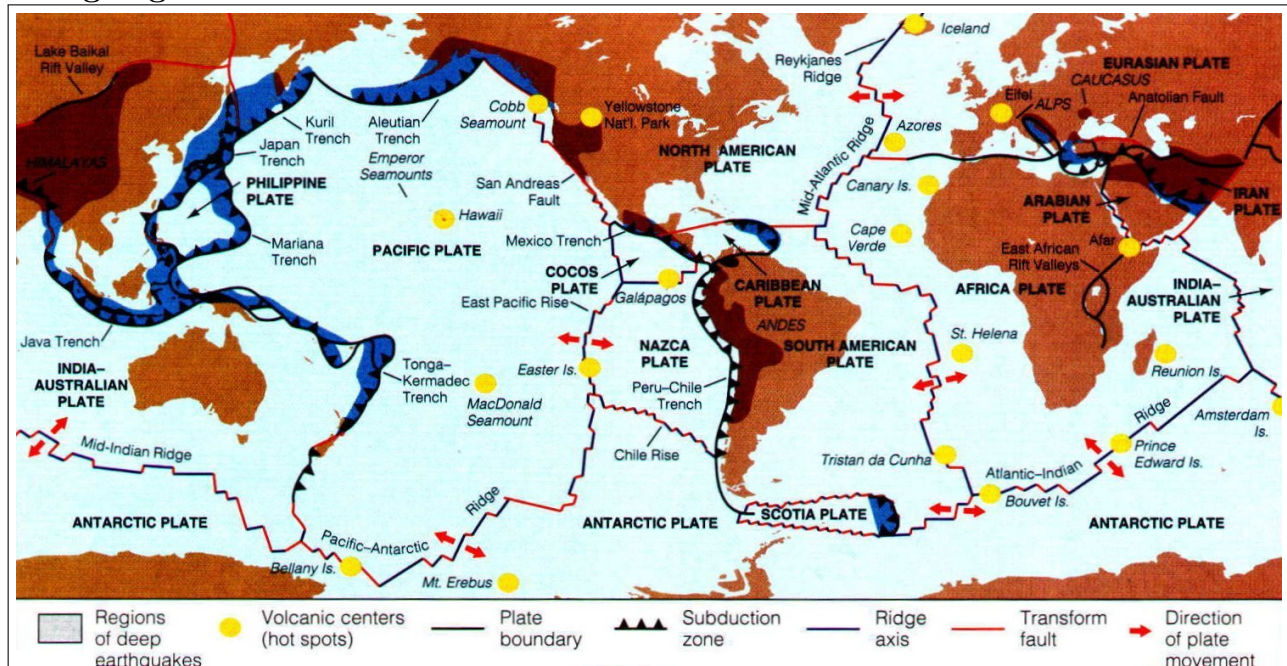


JURASSIC  
145 million years ago

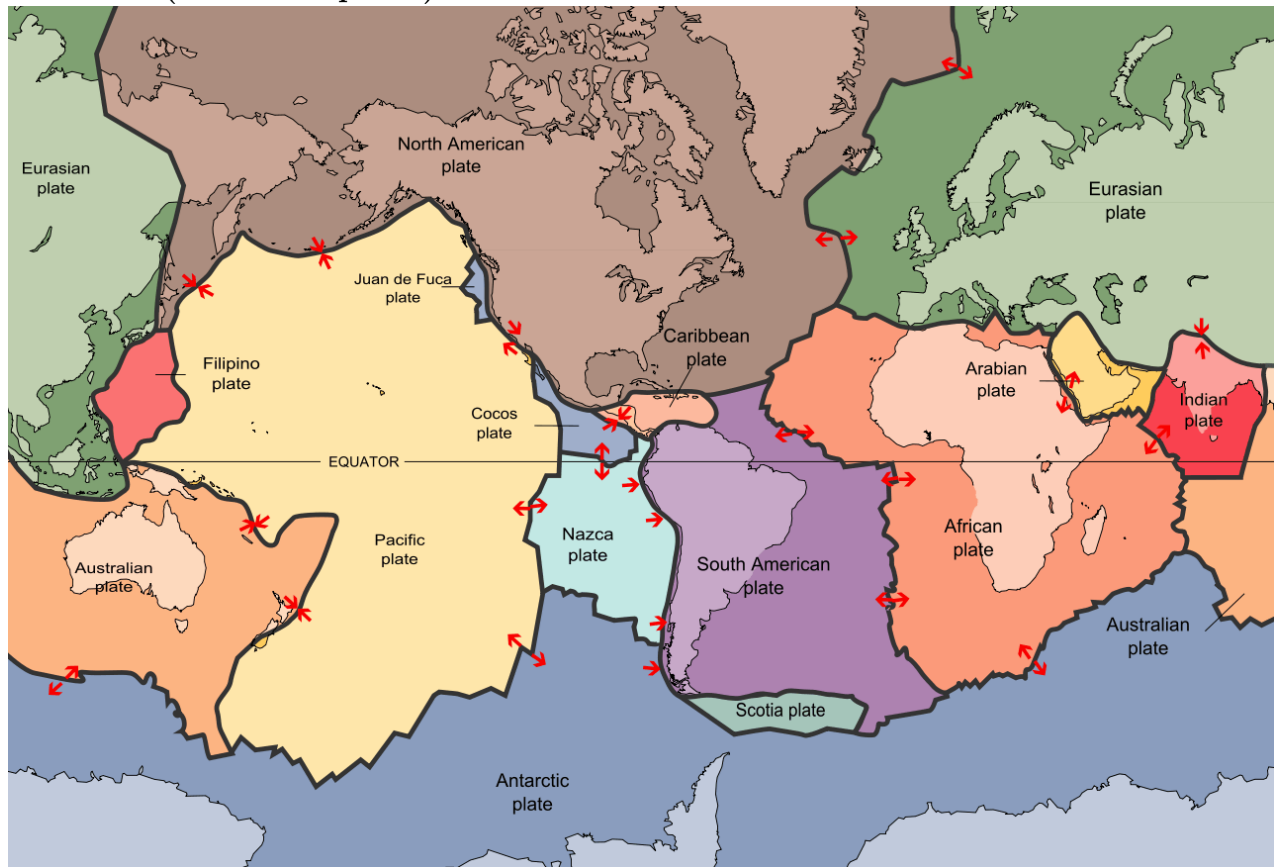


CRETACEOUS  
65 million years ago

What is going on now



Another view (from Wikipedia)

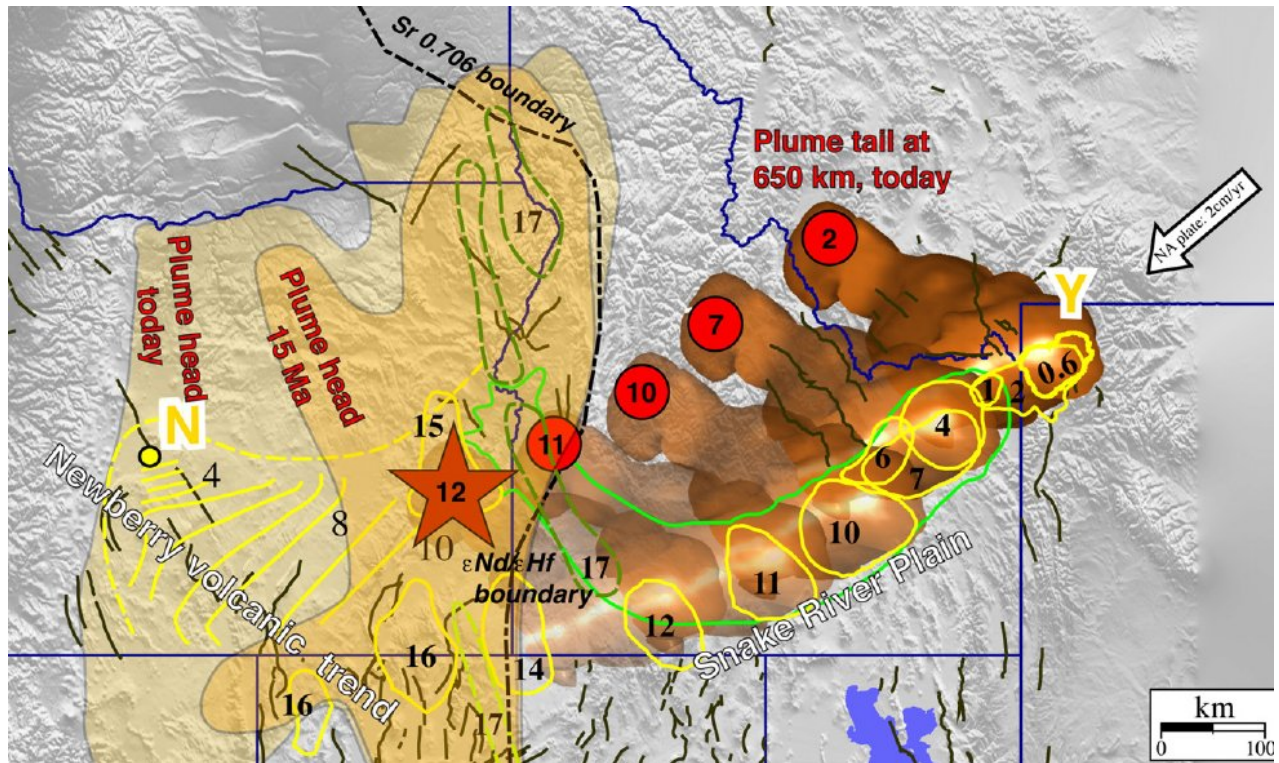


Two living examples of continental drift on U.S. territory

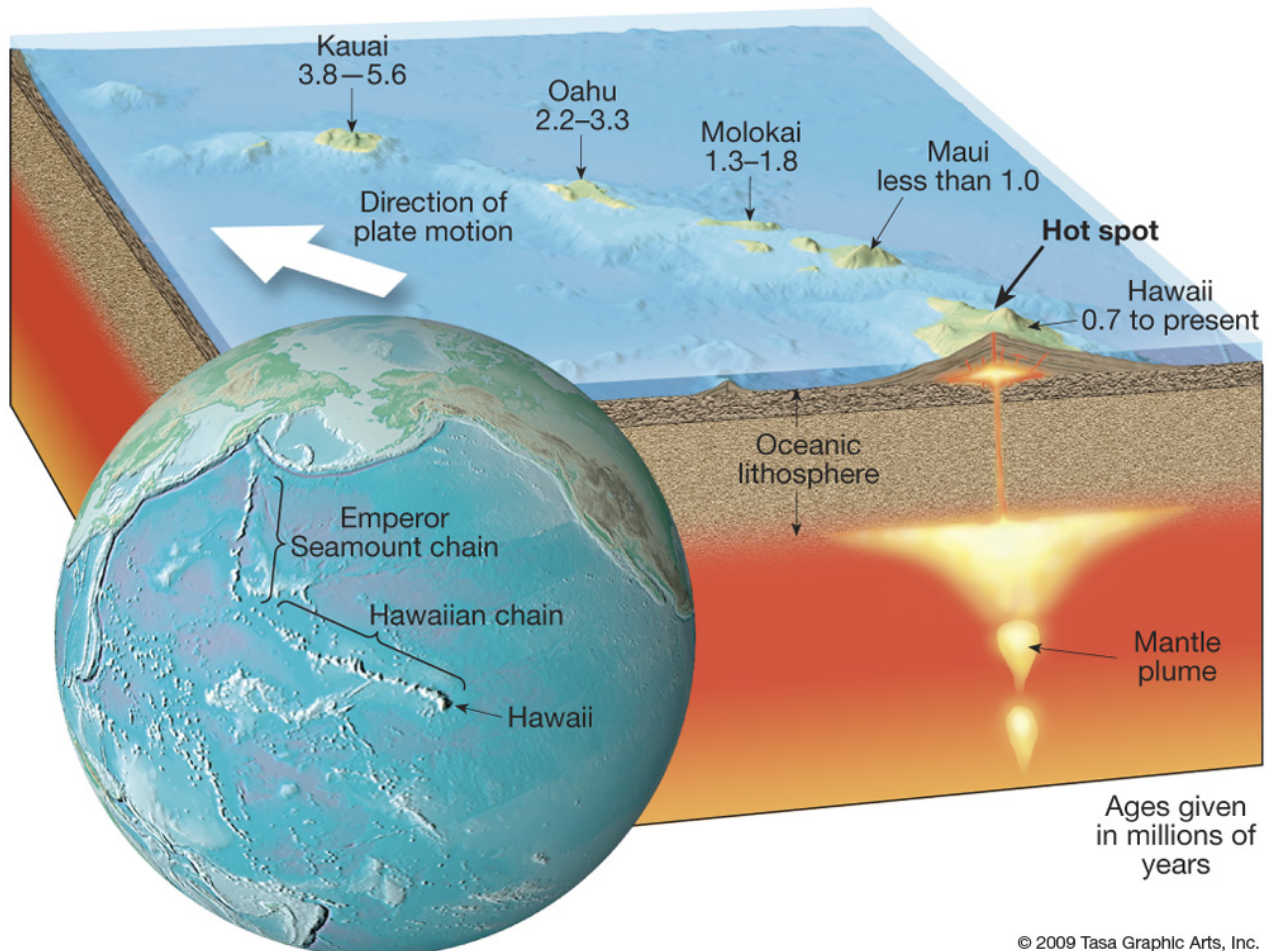
- Yellowstone hotspot
- Hawaiian hotspot

Yellowstone hotspot





## Hawaiian hotspot



## Summary



- 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

## References

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

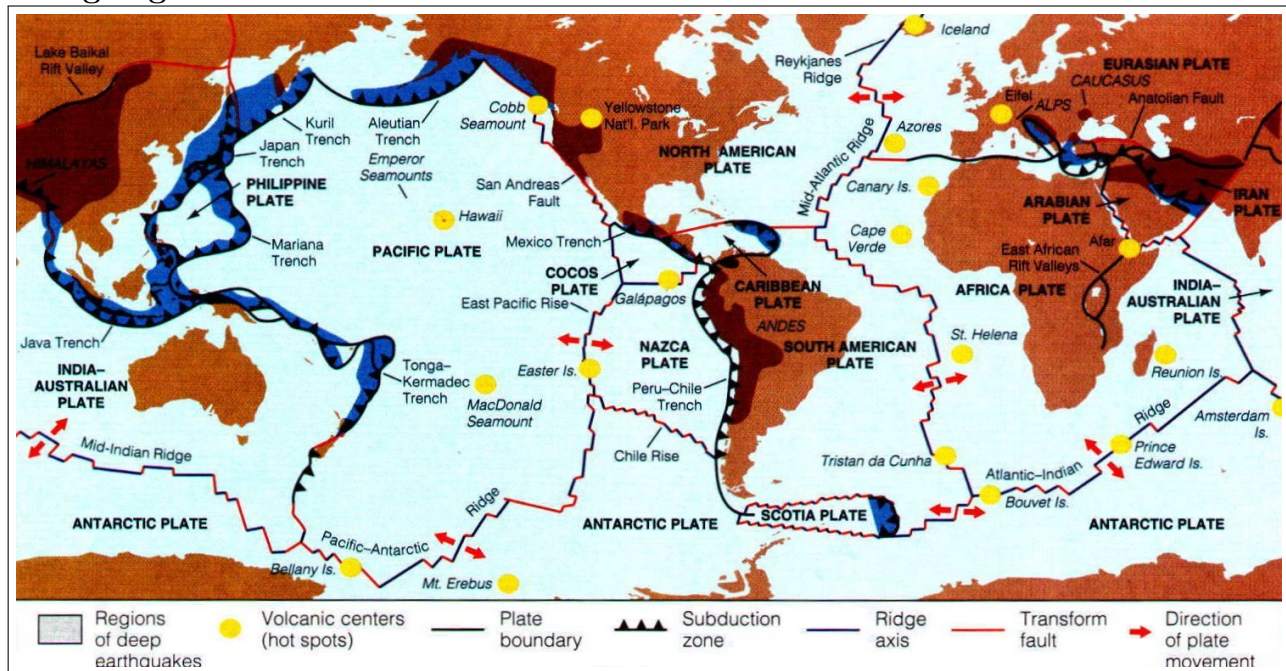
## Outline

# 11 Where we are?

## Continental drift and plate tectonics

- 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
- Two living examples of continental drift on U.S. territory: Yellowstone hotspot and Hawaiian hotspot

## What is going on now



## 12 Origin of life

### 12.1 Proofs of evolution

Evolution is a working research program

“Nothing in Biology Makes Sense Except in the Light of Evolution”

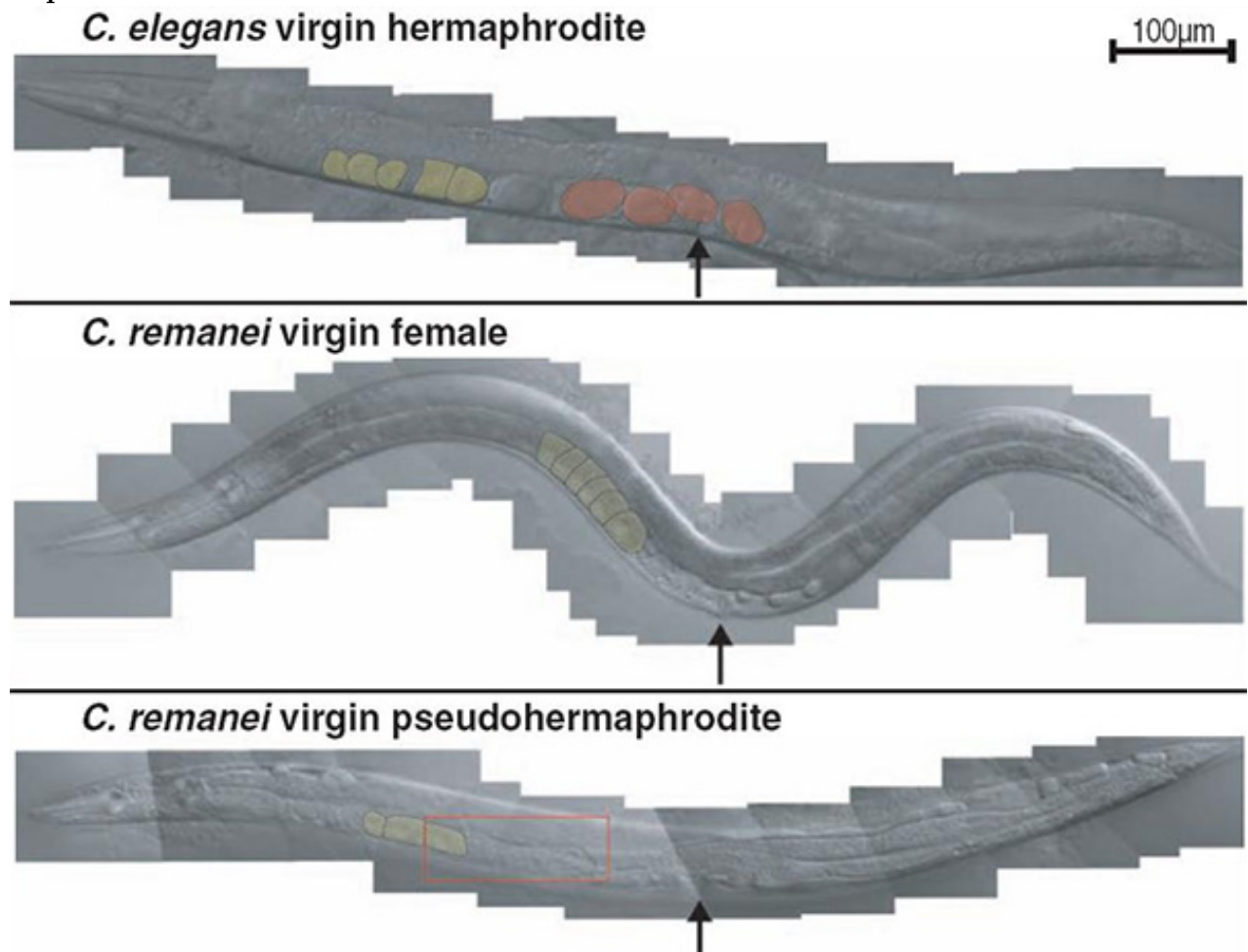
Theodosius Dobzhansky 1973

New useful characters appear as a result of mutations

- Wild rice evolved into domesticable by one mutation: <http://www.sciencemag.org/content/311/5769/1936.short>
- Malaria parasite became resistant to drugs due to one mutation: <http://www.sciencemag.org/content/325/5948/1680.abstract>
- Two mutations may turn worms into hermaphrodites: <http://www.sciencemag.org/content/326/5955/1002.abstract>

and so on

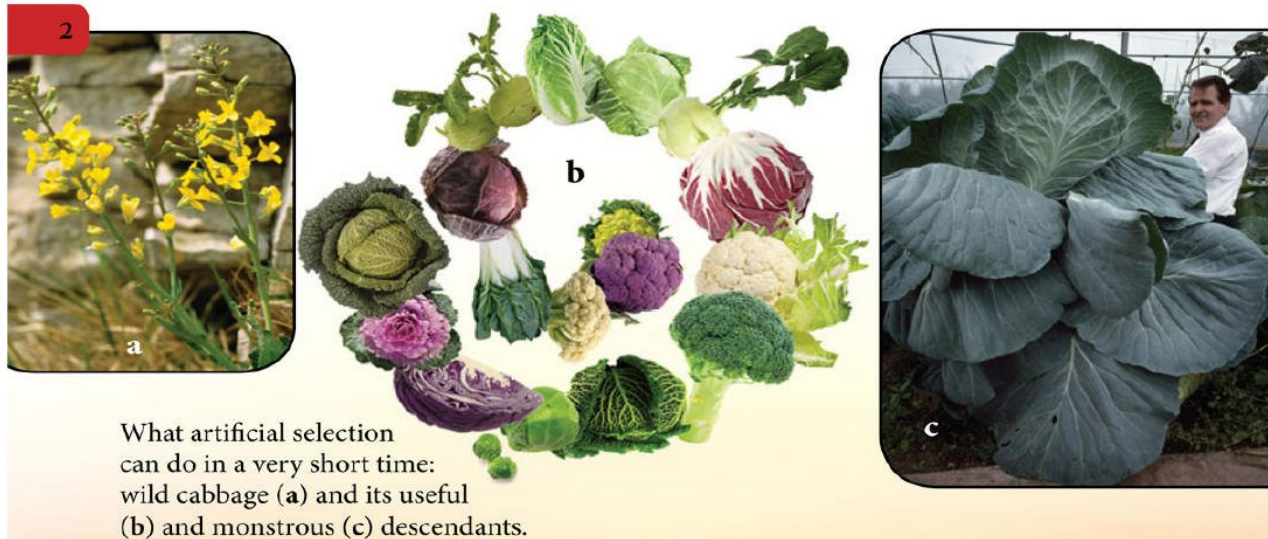
Hermaphroditic worms



## Artificial selection is a bridge to natural selection

- Artificial selection is a full analog of natural selection
- Animals are also doing “artificial” selection
- Results of artificial selection may be called “new species”

### Cabbages



## There are dozens of observed and documented cases of evolution

- Bacteria make major evolutionary shift in the lab (40,000 generations experiment): <http://www.newscientist.com/article/dn14094-bacteria-make-major-evolutionary-shift-in-the-lab.html>
- Harmful insects escaped from viral biological weapons: <http://www.sciencemag.org/content/317/5846/1916.abstract>
- Maggot flies and their parasitic wasps formed several new species for 150 years: <http://www.sciencemag.org/content/323/5915/776.abstract>
- Accidental hybridization turned black chokecherry into delightful fruit (*Aronia melanocarpa* to *Aronia mitchurinii*)
- American evening primrose gave birth to new species, red-stem evening primrose in Europe (*Oenothera biennis* to *Oenothera rubricaulis*) in 100 years

### Apple maggot fly: new species





Black choke cherry and Russian *Aronia mitchurinii* (new species)



Evening primroses: American and European (new species)



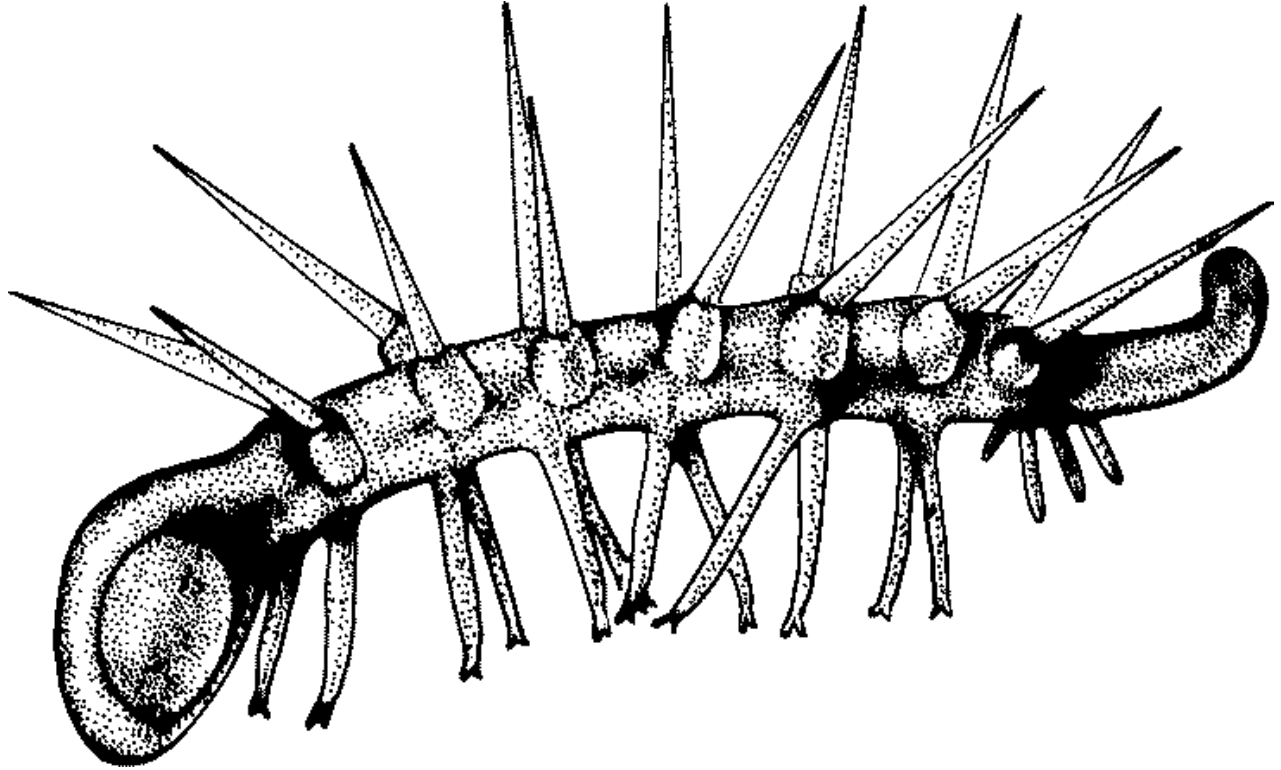
### Fossils are direct evidence of evolution

- The older fossils are, the more unusual are they



- Many fossils are transitional forms (see [http://en.wikipedia.org/wiki/List\\_of\\_transitional\\_fossils](http://en.wikipedia.org/wiki/List_of_transitional_fossils))
- Many fossils could be arranged in well-documented “evolutionary chains”

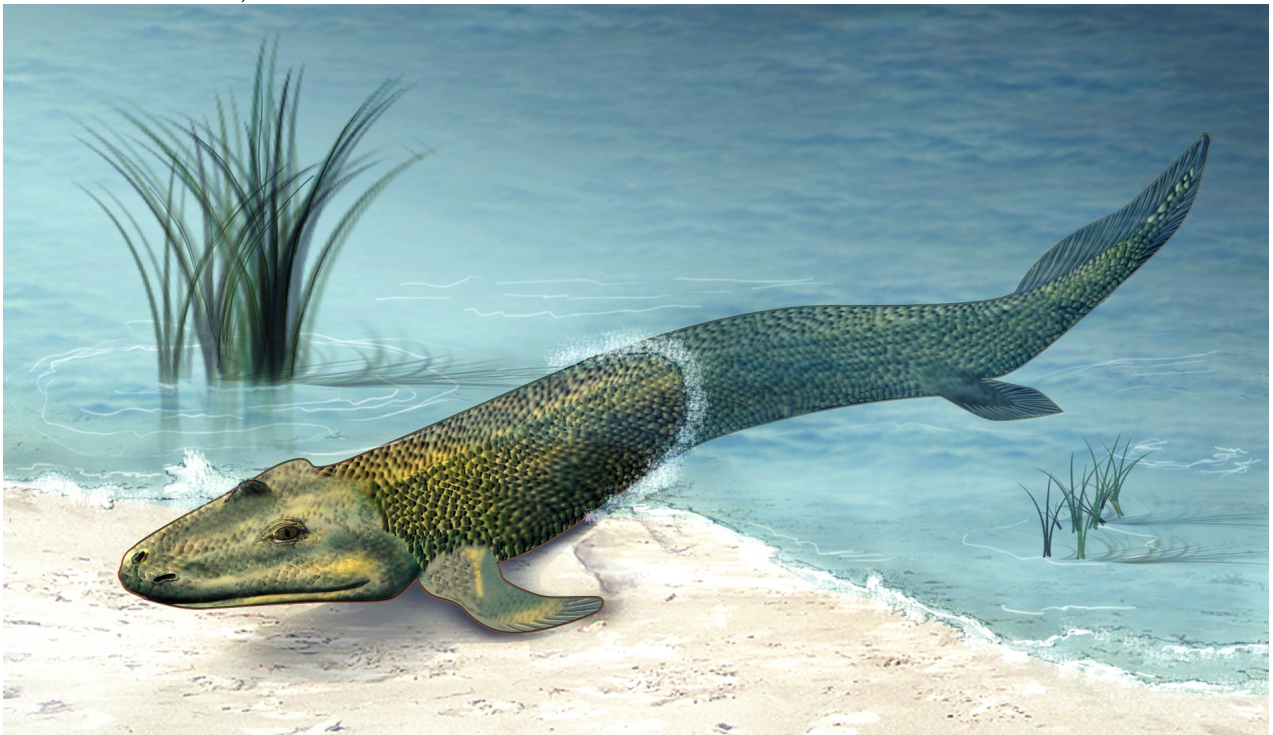
*Hallucigenia*—mysterious Cambrian fossil



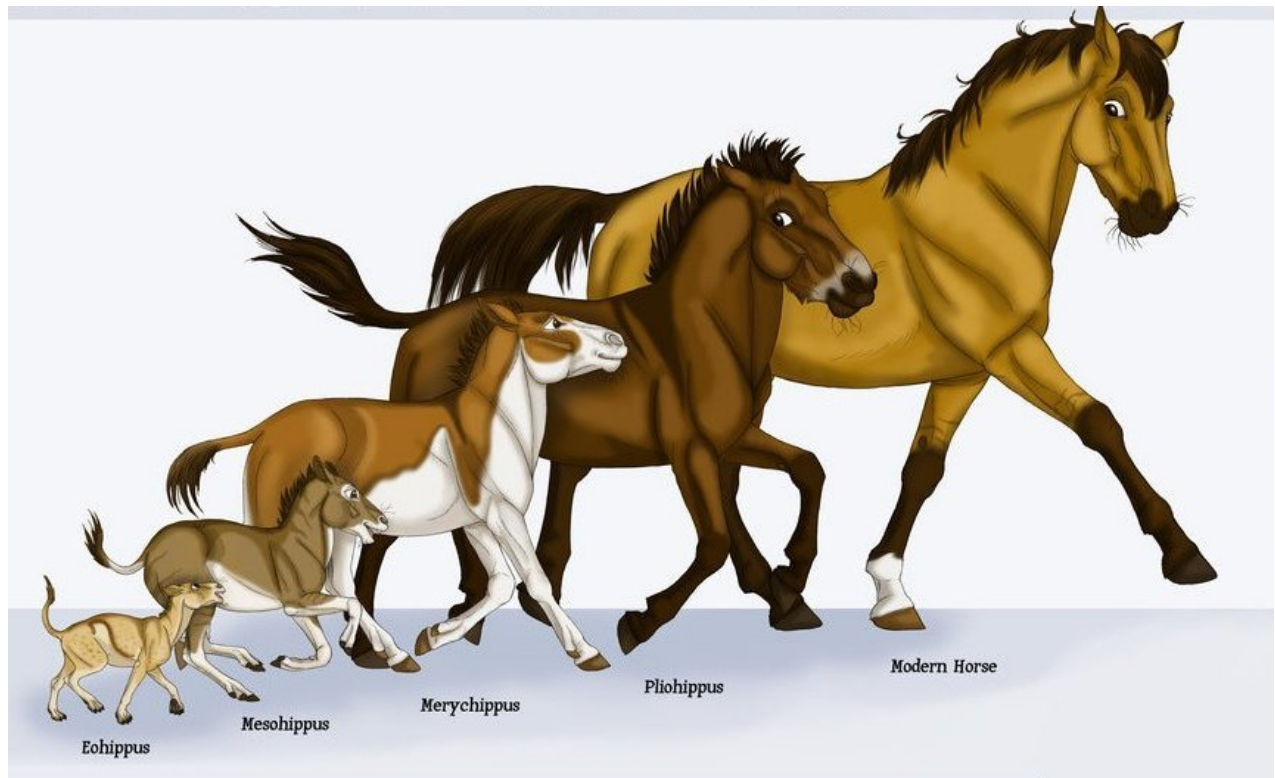
*Hallucigenia* in stone



*Tiktaalik*—half-fish, half-salamander



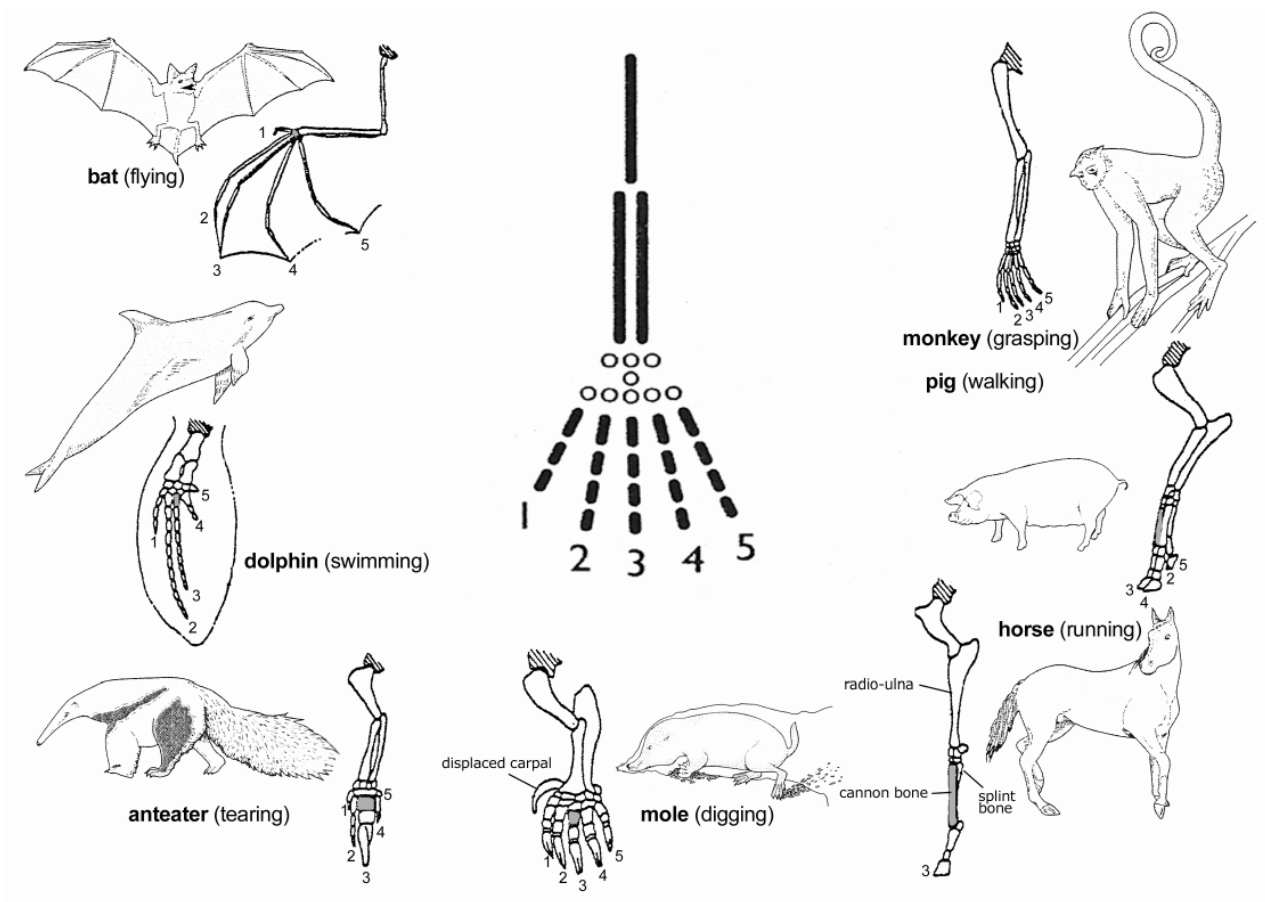
Evolution of horses



### Similarities in structure (morphology) prove evolution

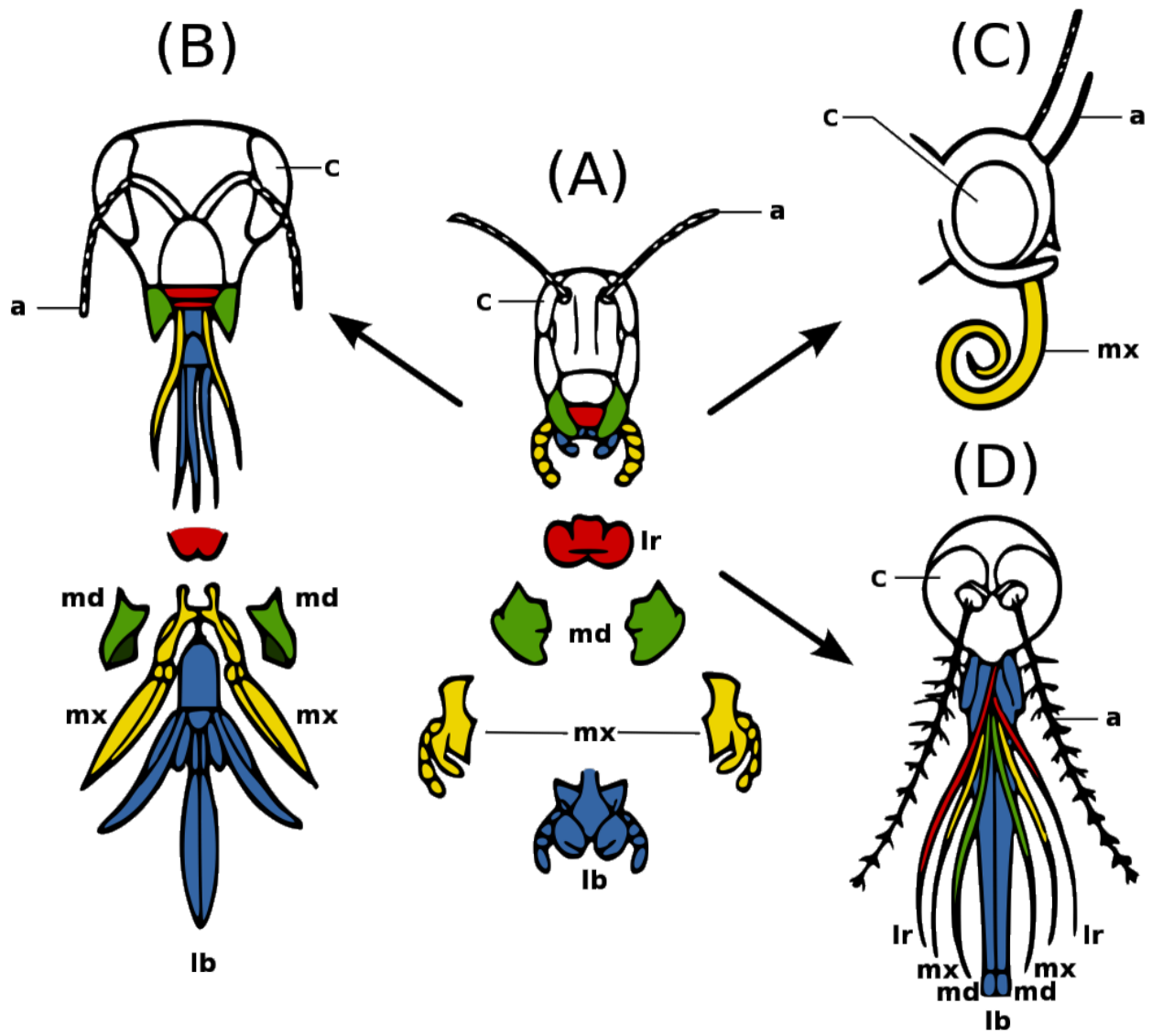
- So-called homological structures are descendants of one ancestral structure
- Vestigial organs remind us of the past
- Reversion organs demonstrate ancestral states
- Analogous structures demonstrate how evolution led to the same outcome

### Pentadactyl limb of terrestrial vertebrates



## Insect mouth

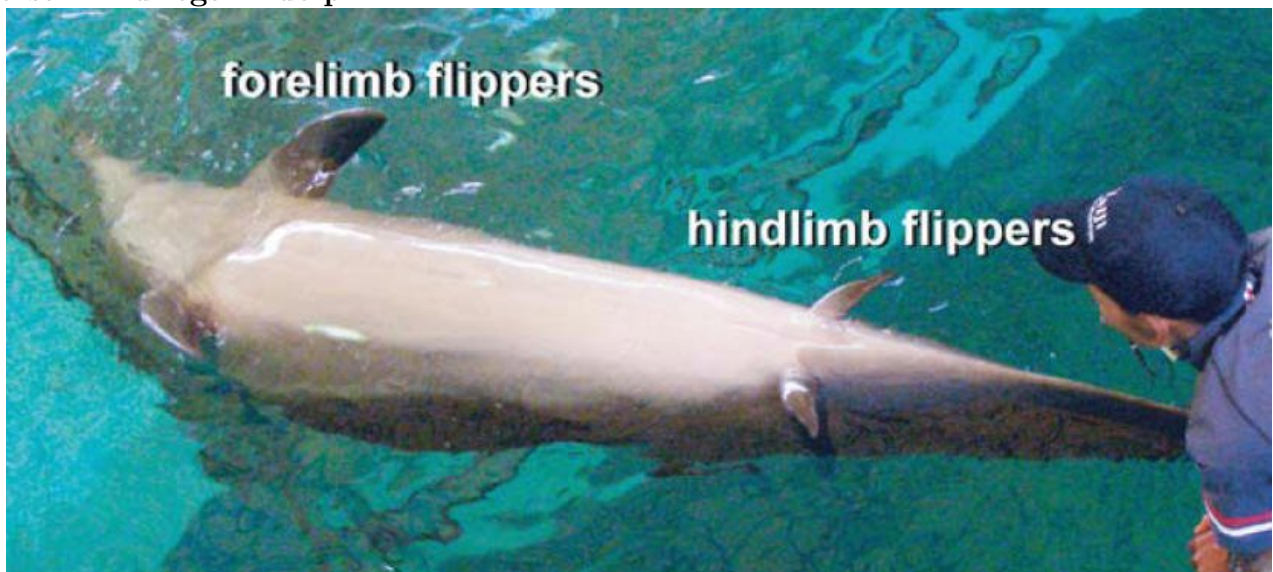




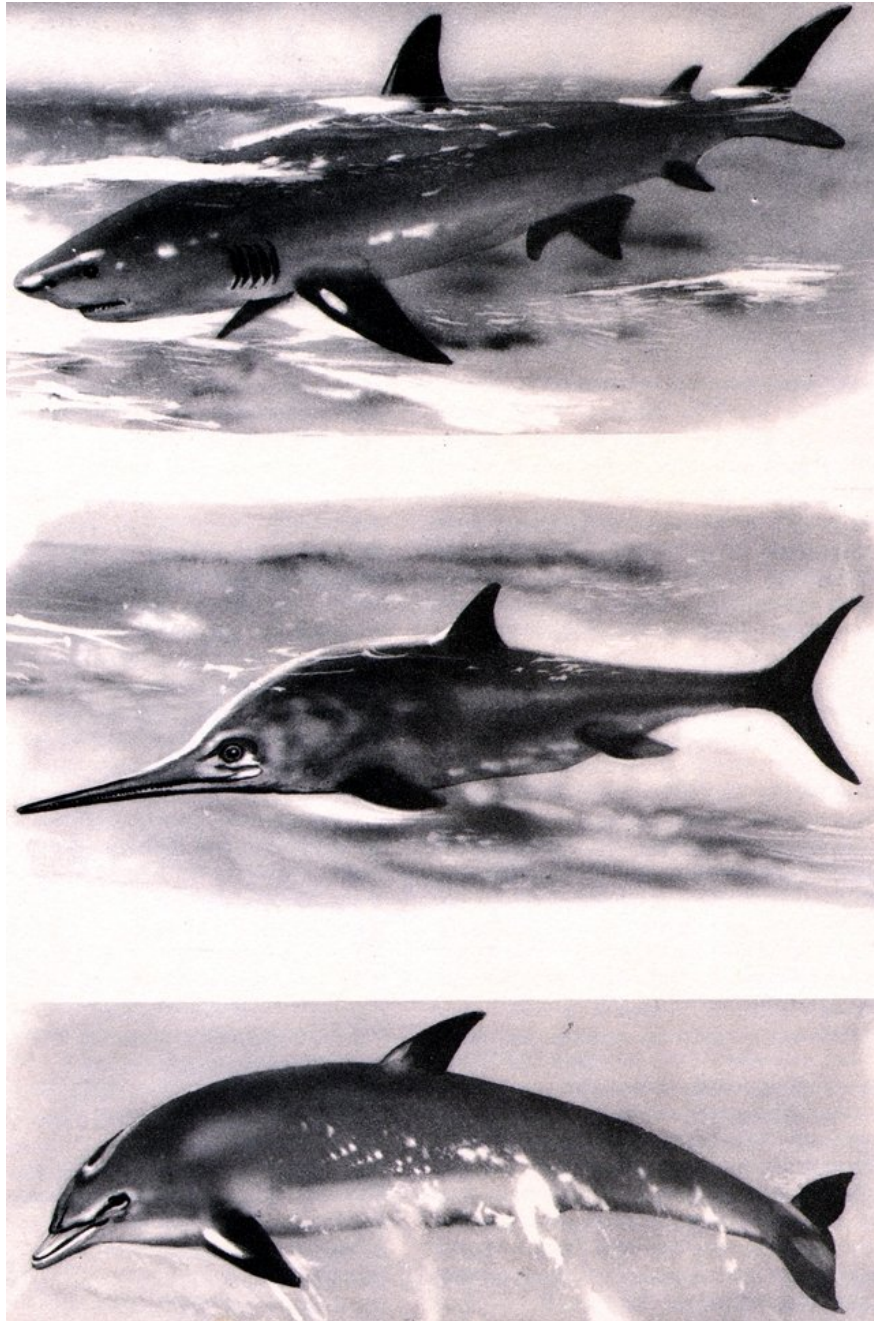
Vestigial hind legs of python



Reversal hind legs in dolphin



Analogous structures help shark, ichthyosaur and dolphin to swim

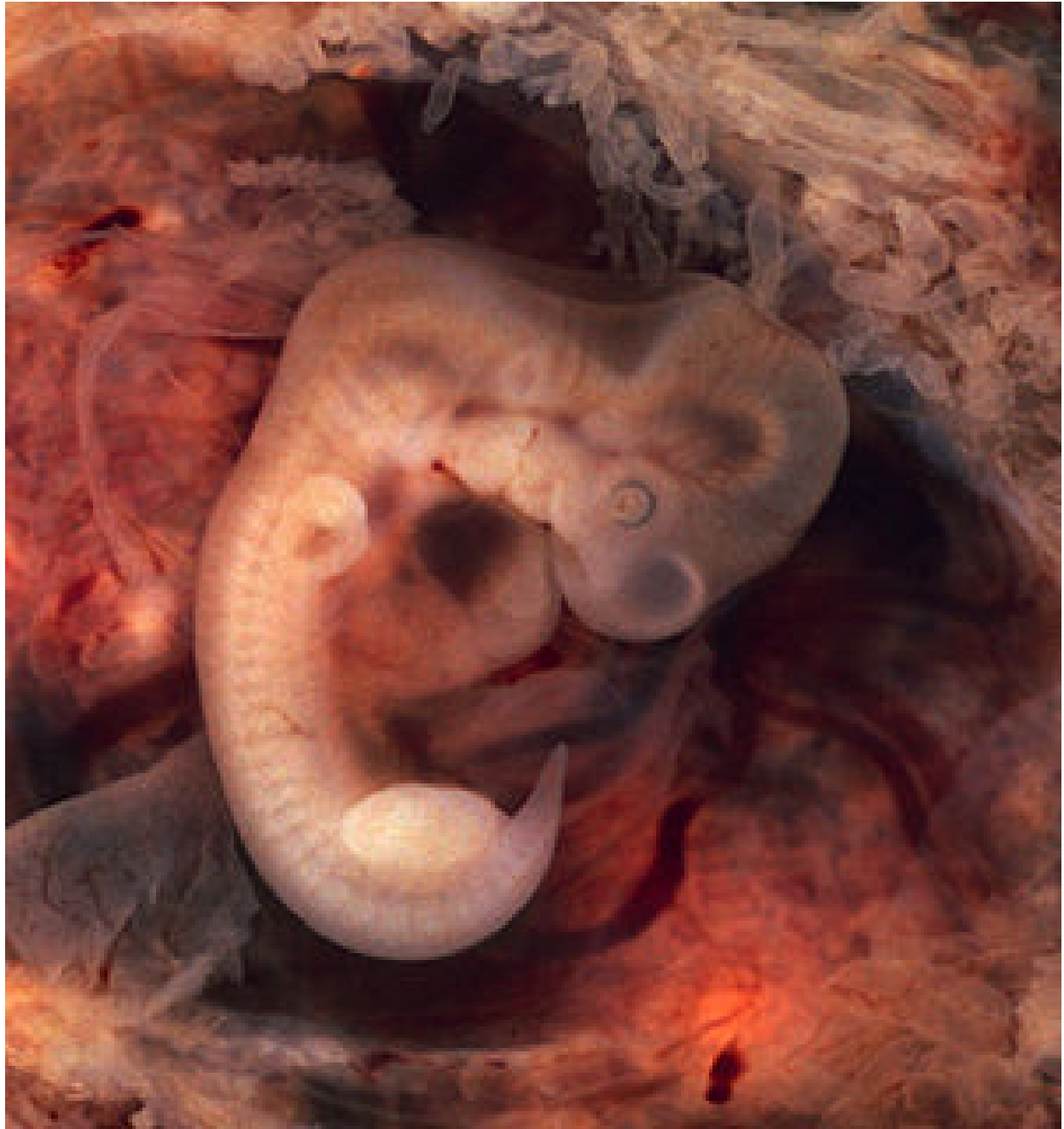


### Embryonic development is another proof

- Embryos retain ancestral characters
- We may now switch development programs and uncover hidden structures

### Mammal embryo with gills





Switching fly back to four wings



## Molecular biology tells about common roots

- All living things have same molecular base
- Genetic distance between close species is small
- Human DNA contains “fossil” viruses: <http://www.biomedcentral.com/1471-2148/8/266> and silenced genes (pseudogenes, e.g., olfactory receptor genes in humans)

## Chimpanzee and human: only 1% difference

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M T P T R K I N P L M K L I N H S F I D
ATGACCCCGACACGCAAAATTAACCCACTAATAAAATTAATTAATCACTCATTTATCGAC 60
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ATGACCCCGAATACGCAAAACCTAACCCCTAATAAAATTAATTAACTCACTCATTCATCGAC 60
M T P M R K T N P L M K L I N H S F I D

L P T P S N I S A W W N F G S L L G A C
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||||||| ||||| ||||| ||||| ||||| ||||| ||||| |||||
CTCCCCACCCCATCCAACATCTCCGCATGATGAACTTCGGCTCACTCTTGGCGCCTGC 120
L P T P S N I S A W W N F G S L L G A C

L I L Q I T T G L F L A M H Y S P D A S
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CTGATCCTCAAATCACACAGGATATTCCTAGCATGCACTACTCACCAGACGCCTCA 180
L I L Q I T T G L F L A M H Y S P D A S
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## Biogeography shows why species evolve

- Isolated islands and small continents facilitate analogous forms (parallel evolution and radiation)
- Many groups of animals and plants now reflect Gondwanan distribution

Can you distinguish Australian sugar glider from American flying squirrel?





*Araucaria* is growing only in South America, New Zealand and Australia



Evolution evolved from hypothesis to the fact and then to research program

- A. Hypothesis
- B. Theory
- C. Fact
- D. Research program

Questions before exam 1?

### Summary

- Given the amount of evidence presented, evolution is a fact
- Evolution is also an extremely useful, working research program, both in biology and medicine

### For Further Reading

## References

- [1] Evolution. <http://en.wikipedia.org/wiki/Evolution>
- [2] Evidence of common descent. [http://en.wikipedia.org/wiki/Evidence\\_of\\_common\\_descent](http://en.wikipedia.org/wiki/Evidence_of_common_descent)

# Example questions for the exam

Start time \_\_\_\_\_

End time \_\_\_\_\_

## Multiple choice

Every question in this section costs either 1 or 0. Please **mark** the appropriate answer on the **scantron**.

A. If tap water has pH equal to 6.8, it is:

- (a) Slightly acidic
- (b) Neutral
- (c) Slightly basic

B. Laurasia:

- (a) Was a super-continent which included all contemporary continents
- (b) Was a continent which broke into South America, Australia, Antarctic, Africa and India
- (c) Was a continent which broke into North America and Europe

C. Who did speculate about extra-terrestrial teapot as an example of non-falsified hypothesis?

- (a) Bertrand Russel
- (b) Charles Darwin
- (c) Theodosius Dobzhansky

D. What is the molecular weight of sulfuric acid,  $\text{H}_2\text{SO}_4$ ? Atomic weights: H=1, O=16, S=32.

- (a) 7
- (b) 49
- (c) 98

## Answers

1A, 2C, 3A, 4C