

A History of (Mostly Vertebrate) Locomotion

1,000,000,000 years in 40 minutes

Kara Feilich and Andrew Yegian

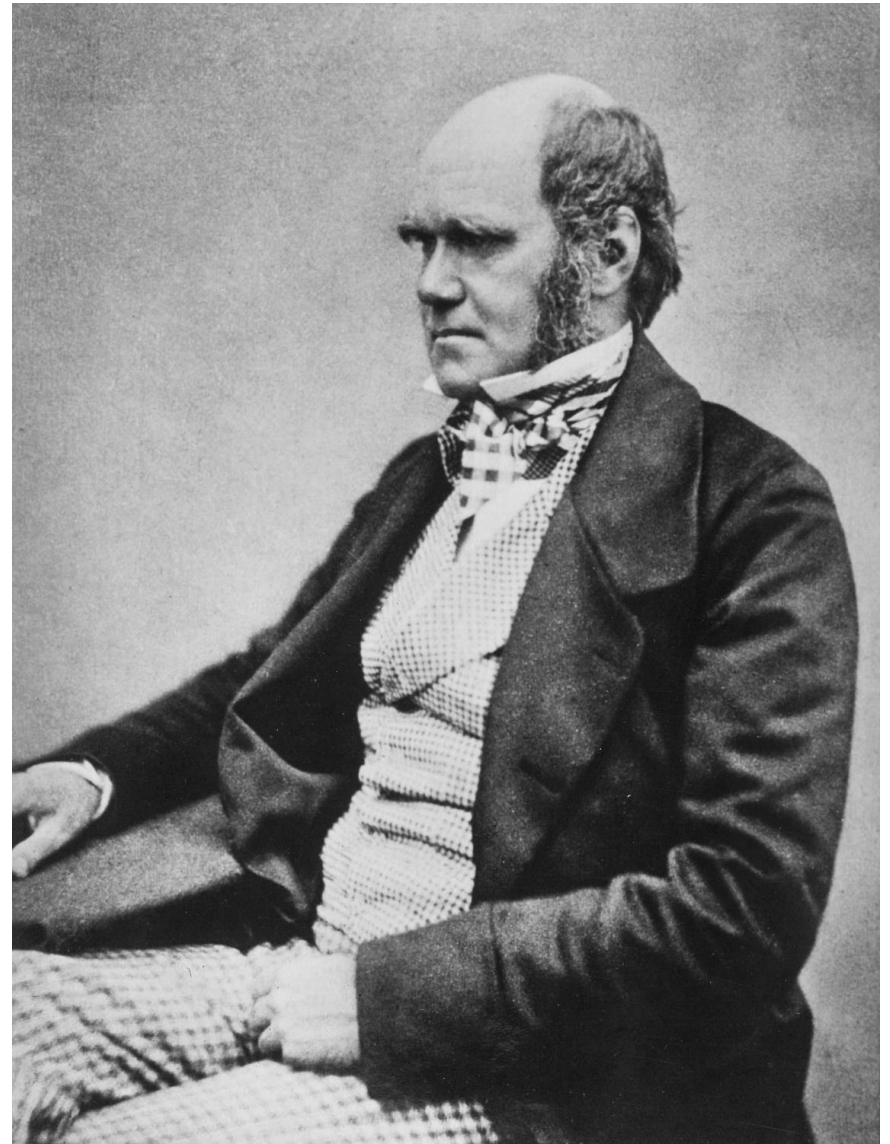
DayCon 2016



1859

Charles Darwin

On the Origin of Species

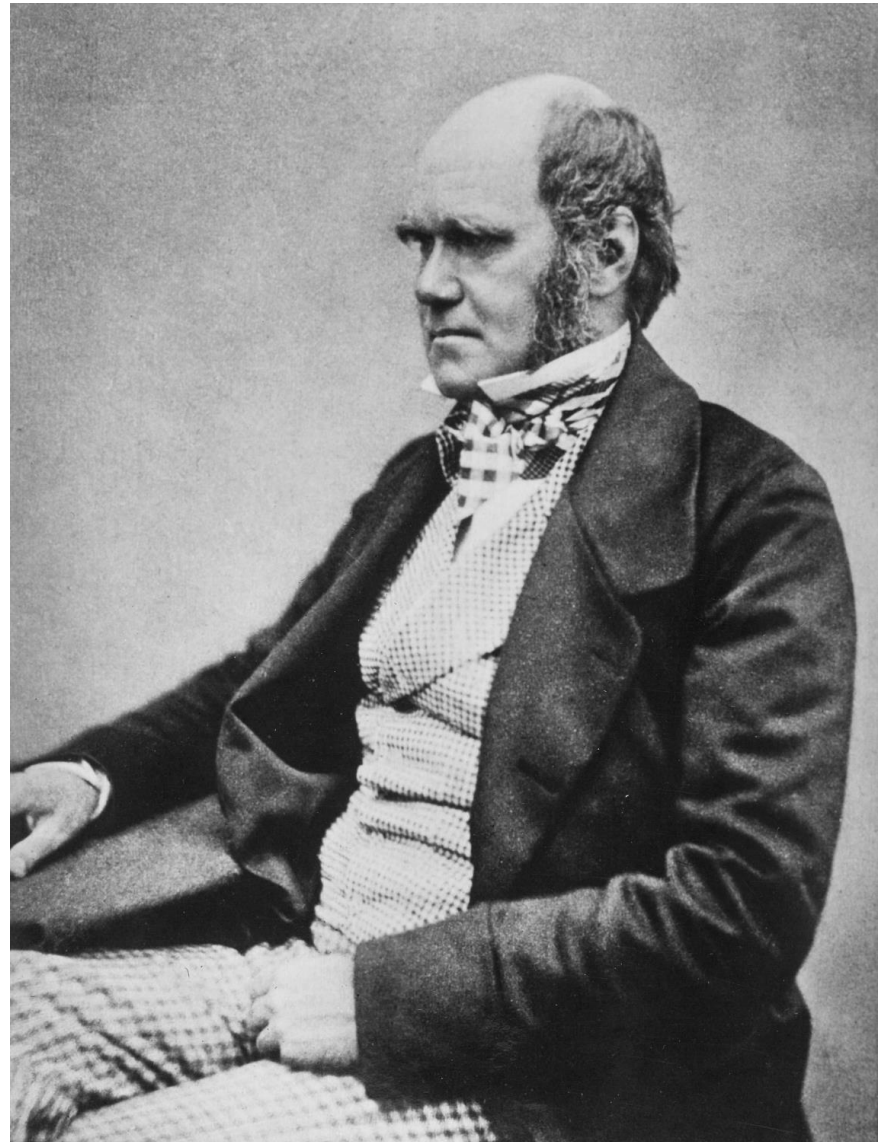


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**“descent with
modification”**



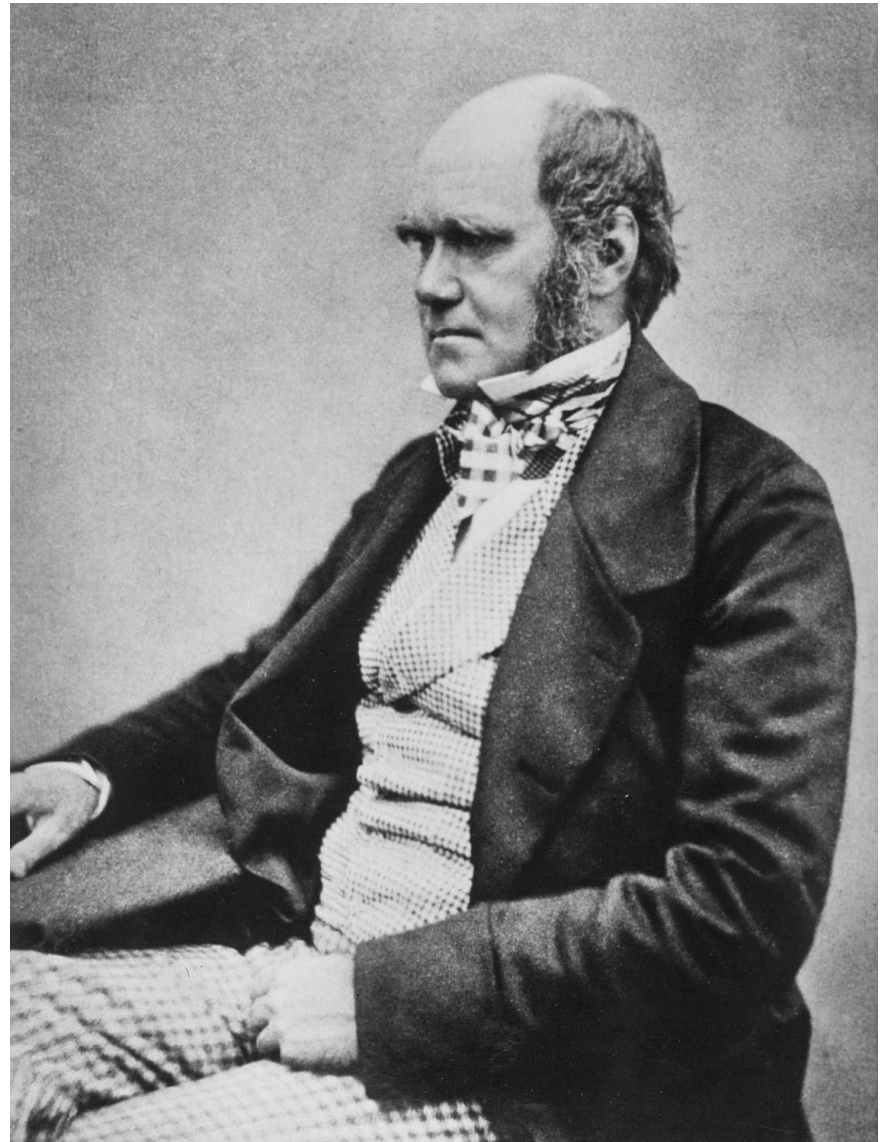
1859

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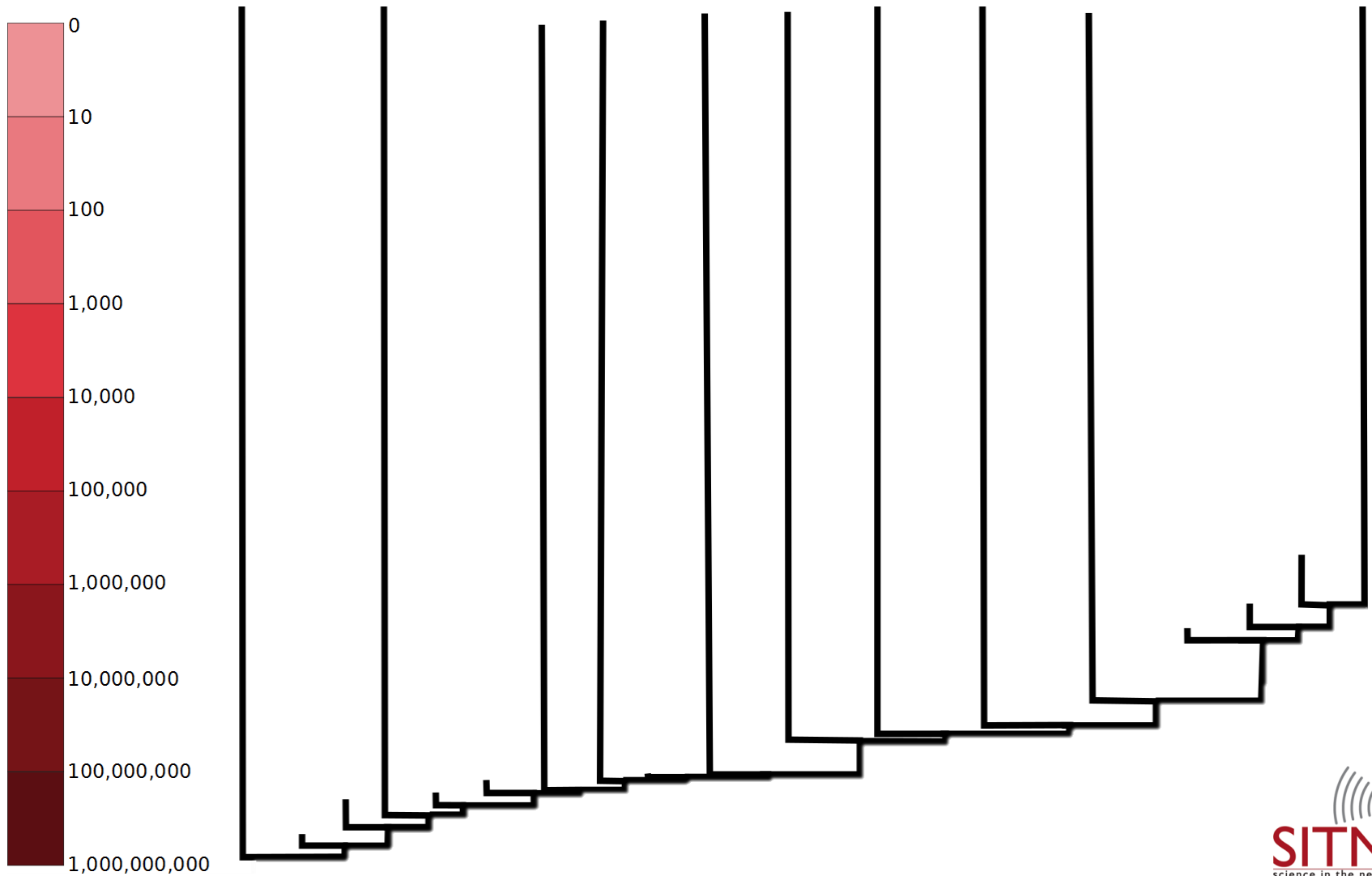
On the Origin of Species

**“descent with
modification”**

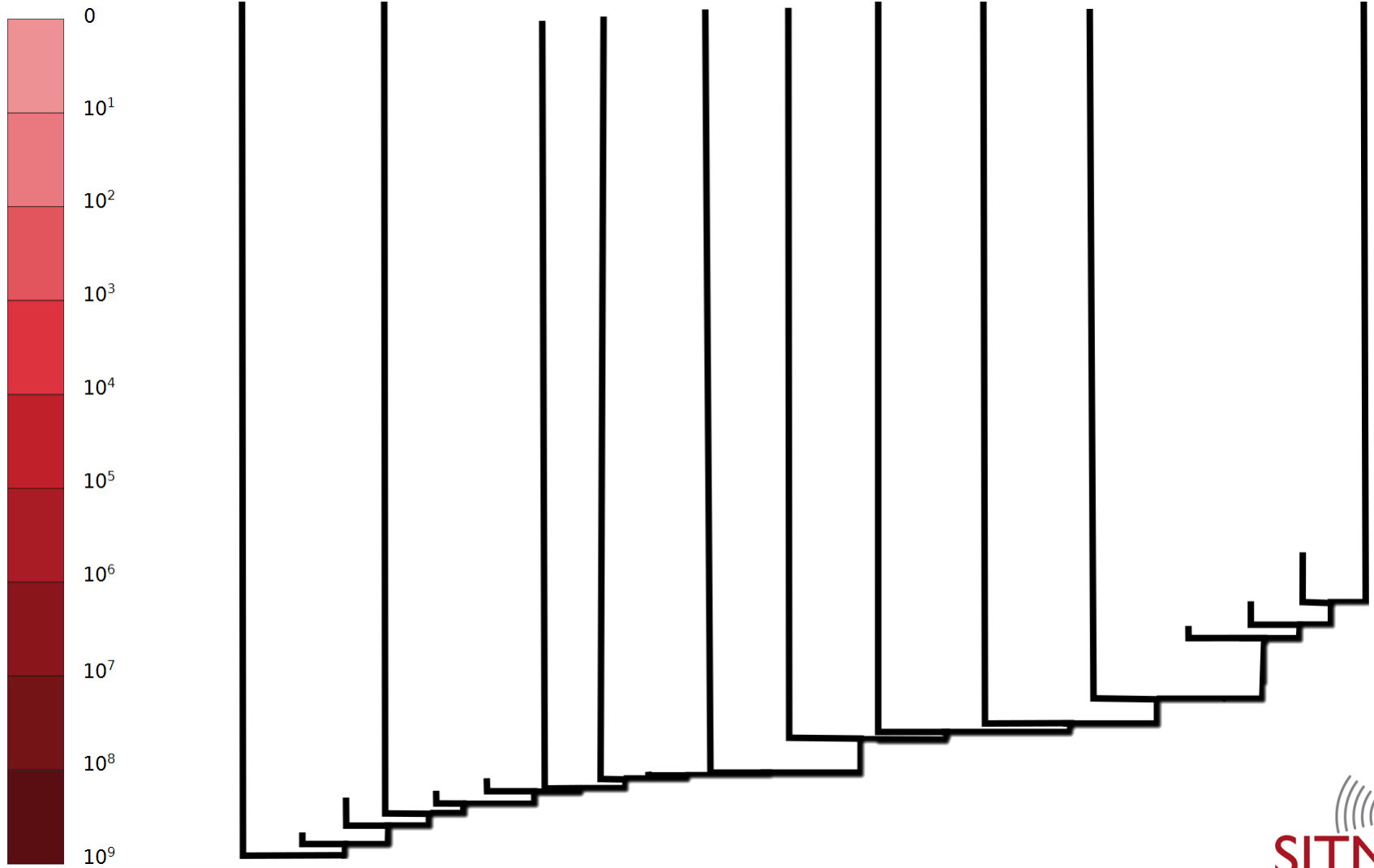
**i.e. animals are related to
each other and descended
from common ancestors**



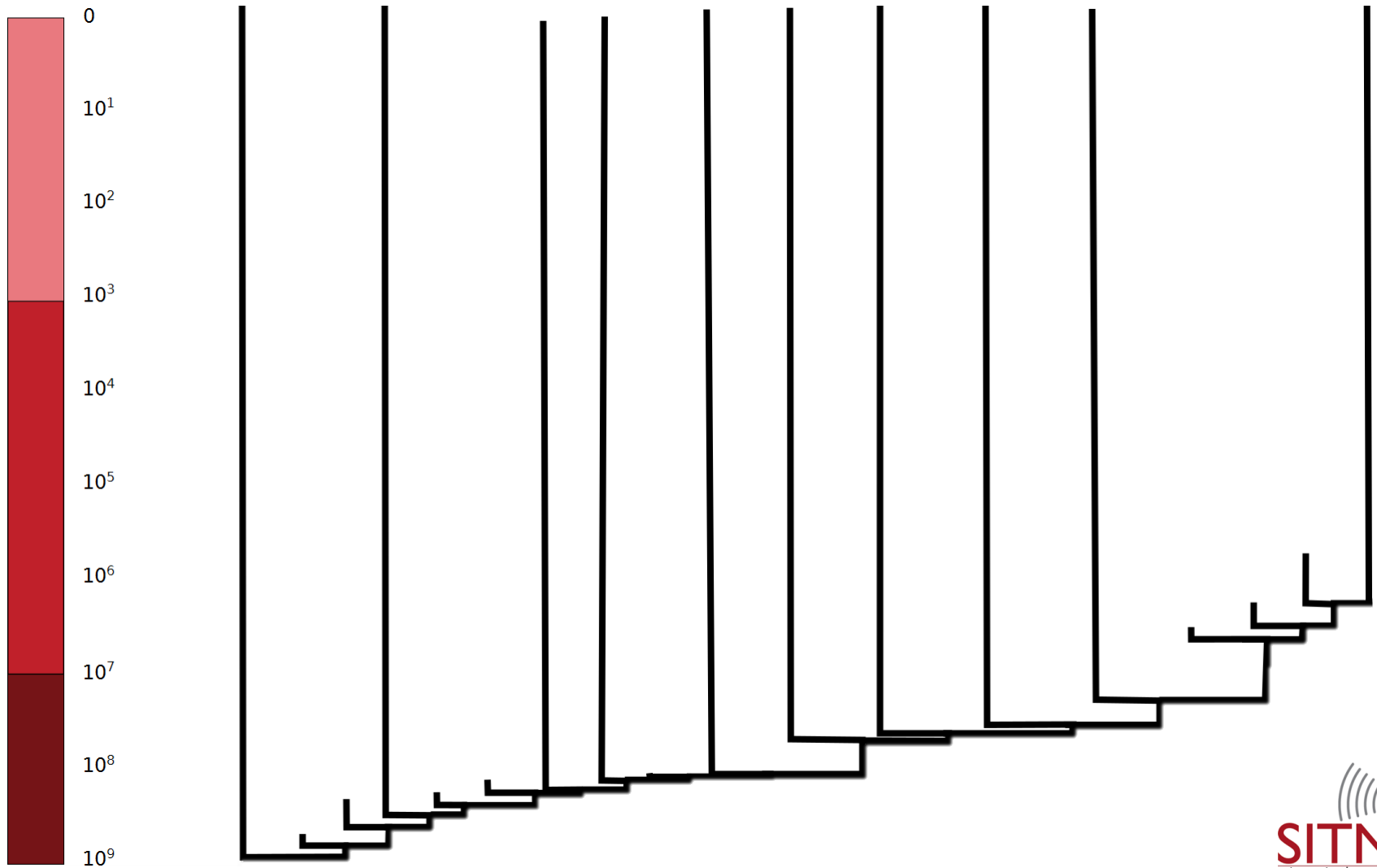
The Timeline



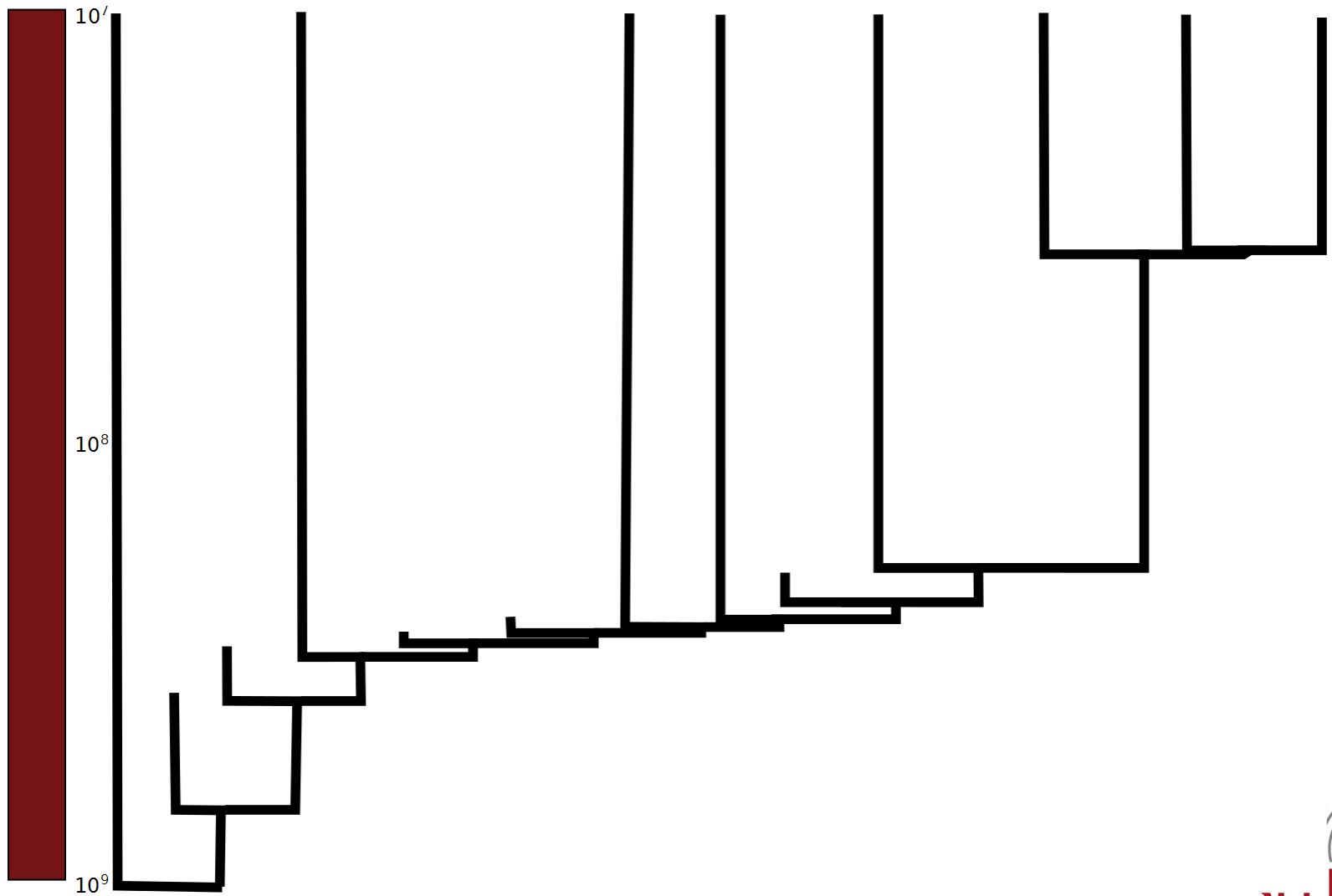
The Timeline



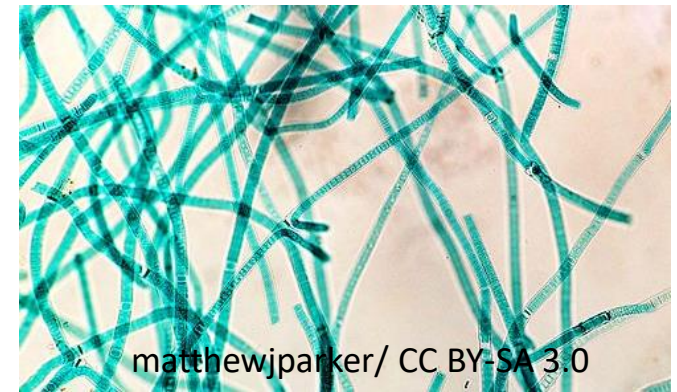
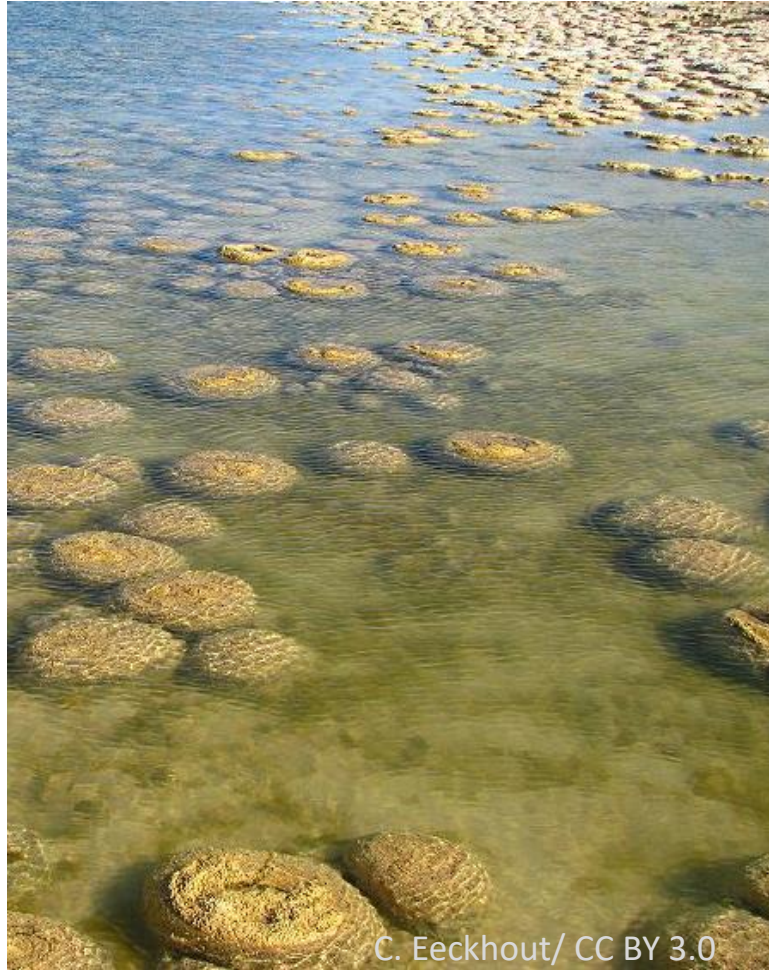
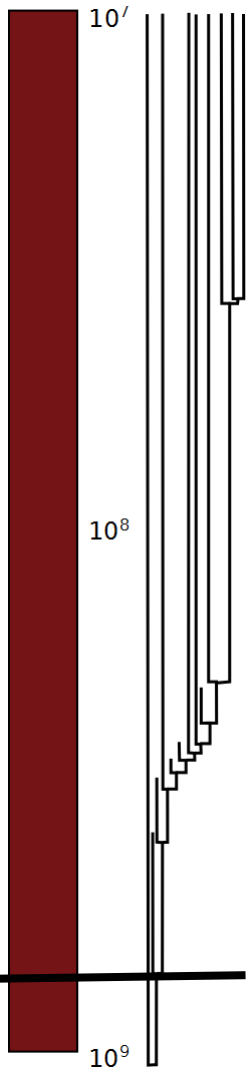
The Timeline



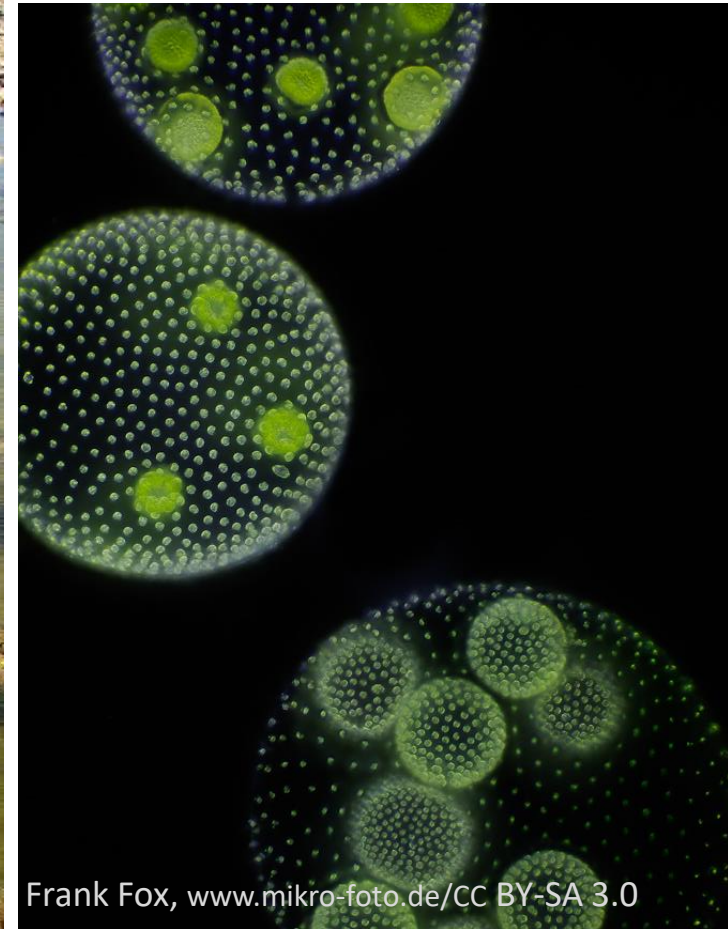
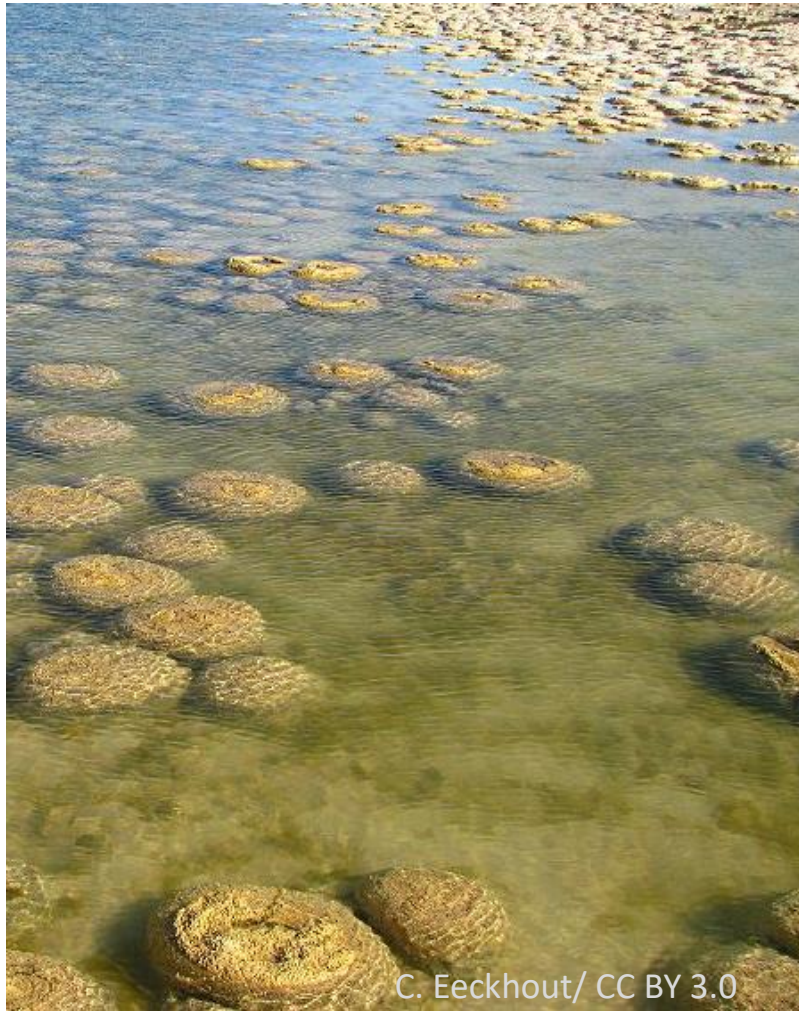
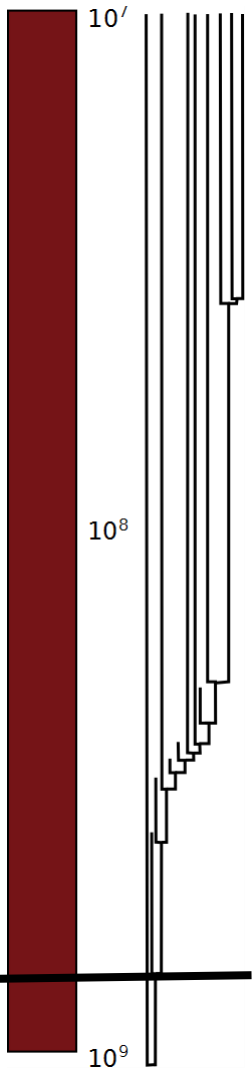
The beginning



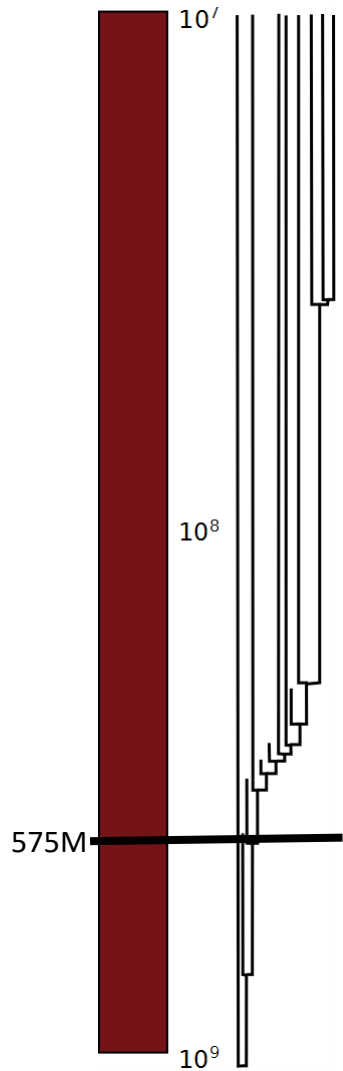
From one cell, many



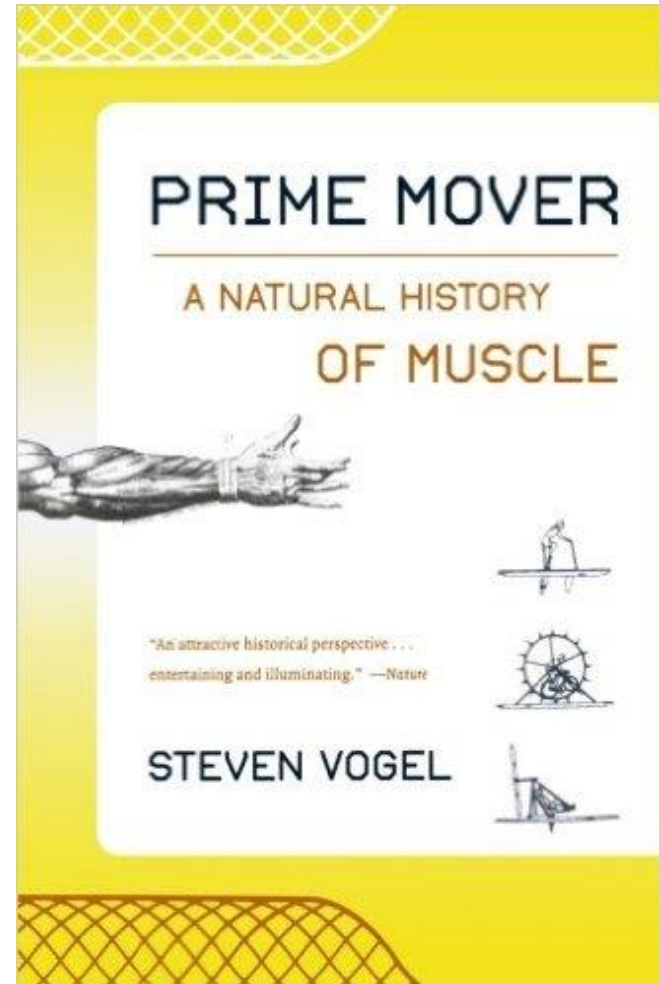
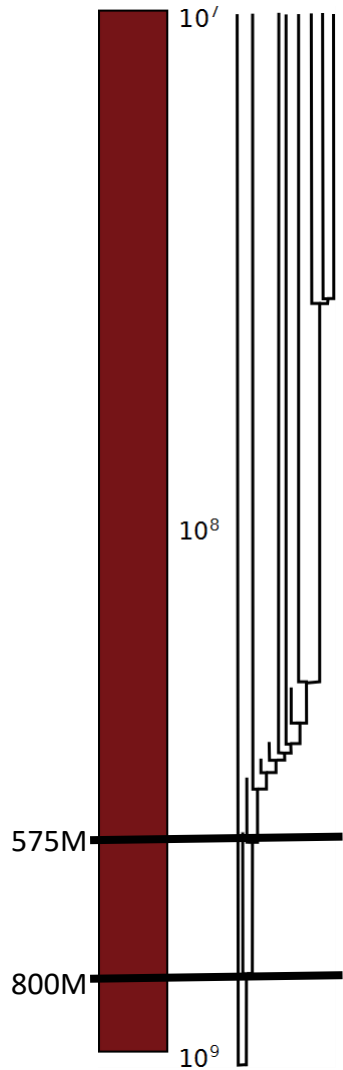
From one cell, many



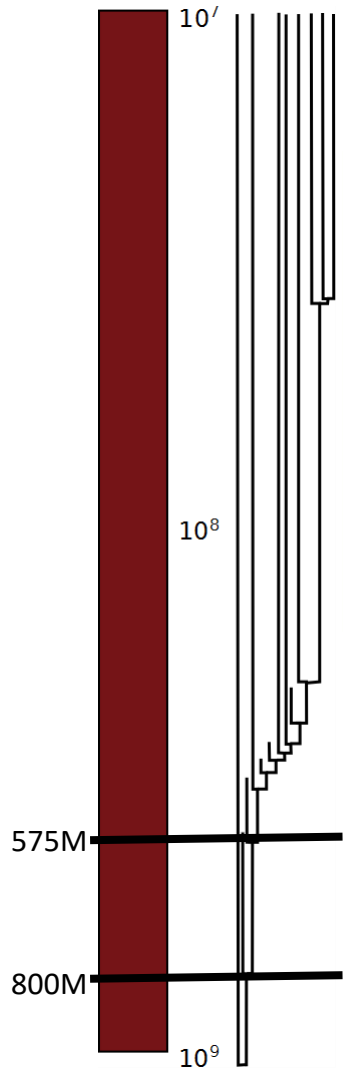
Multiple cells allows for specialized tissues



Muscle: The “Prime Mover”



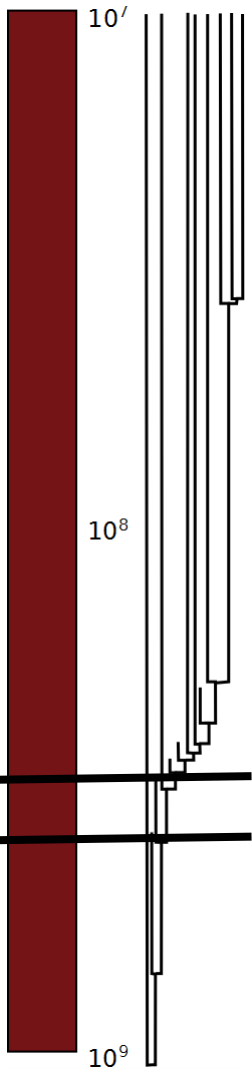
Muscle: The “Prime PULLER”



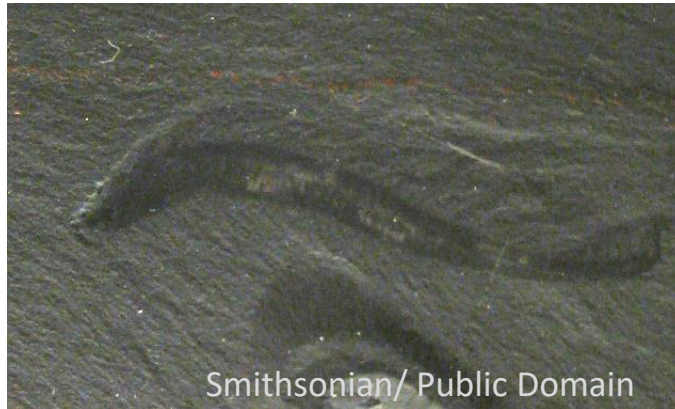
Kara Feilich

K.L. Feilich

Muscles and Little Else



Matteo De Stefano-MUSE/ CC BY-SA 3.0

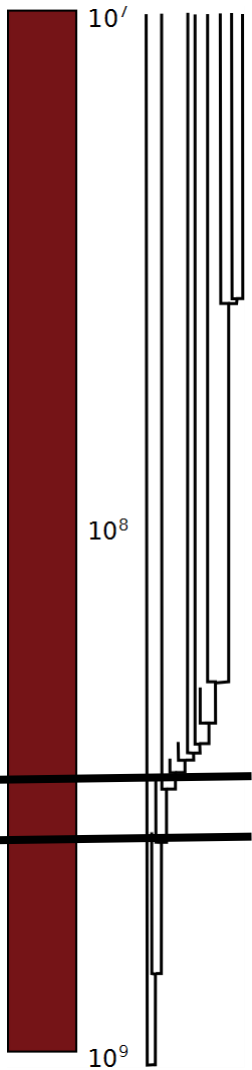


Smithsonian/ Public Domain

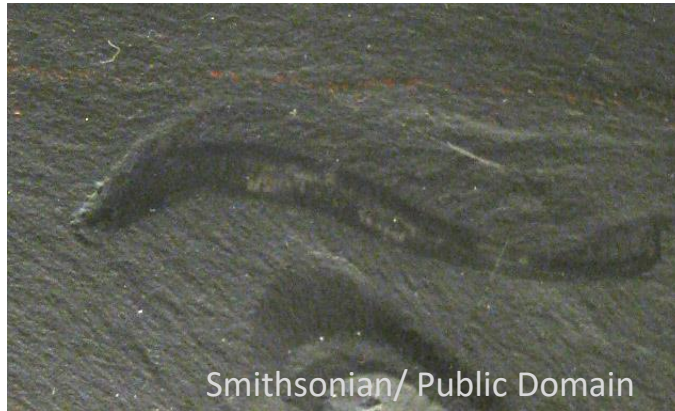


Hans Hillewaert/ CC BY-SA 4.0

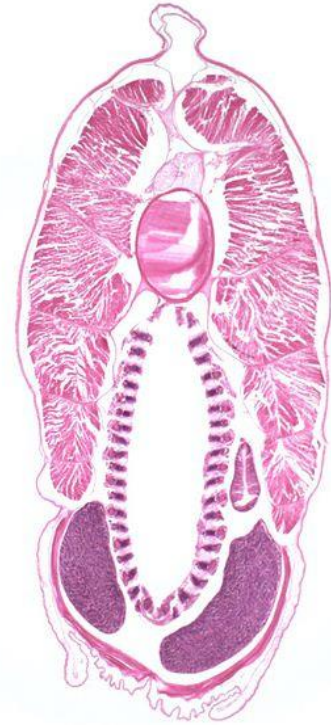
Muscles and Little Else



Matteo De Stefano-MUSE/ CC BY-SA 3.0

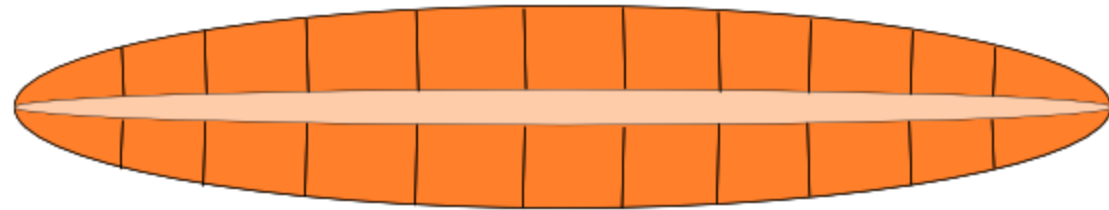
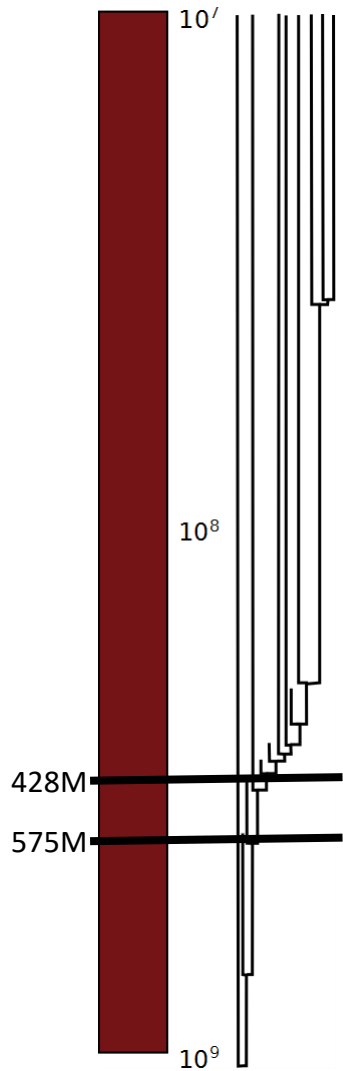


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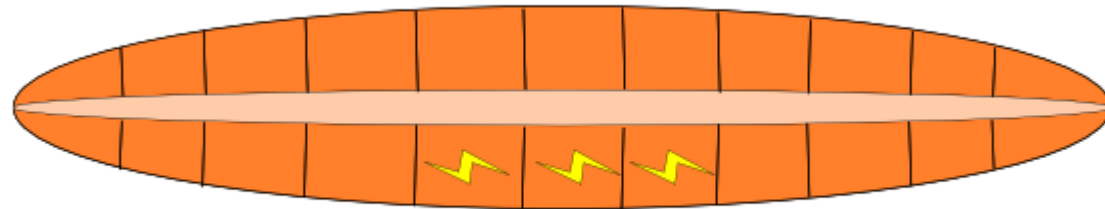
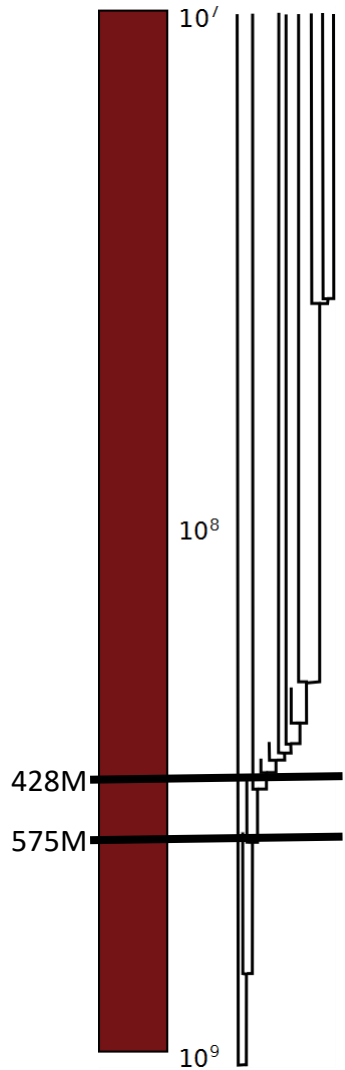
Jon Houseman/ CC BY-SA 3.0

Muscles and Little Else



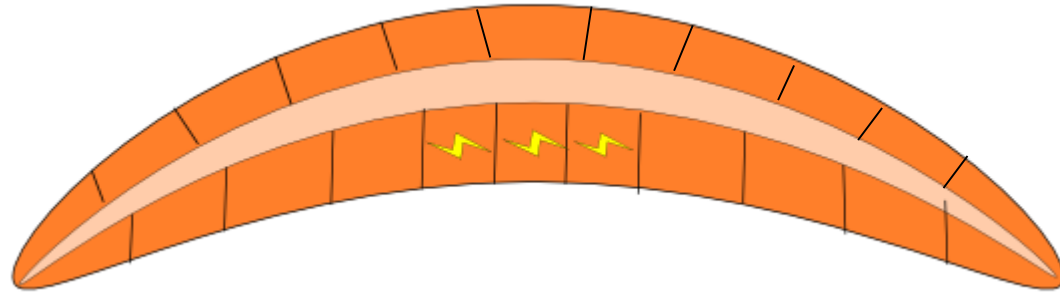
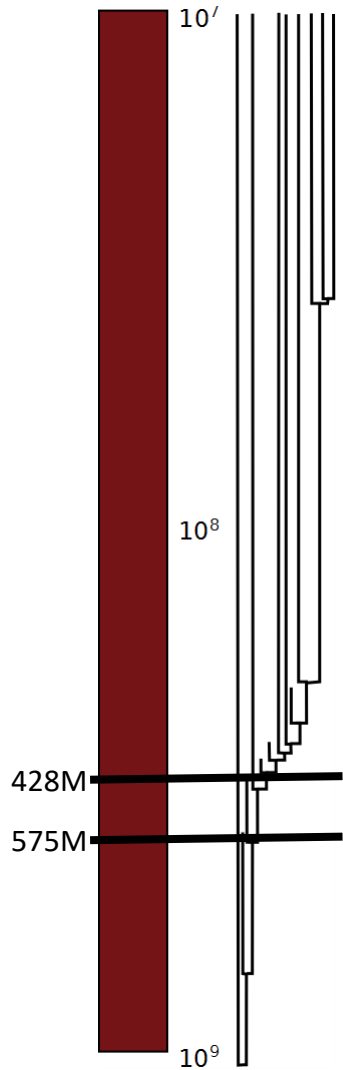
K.L. Feilich

Muscles and Little Else



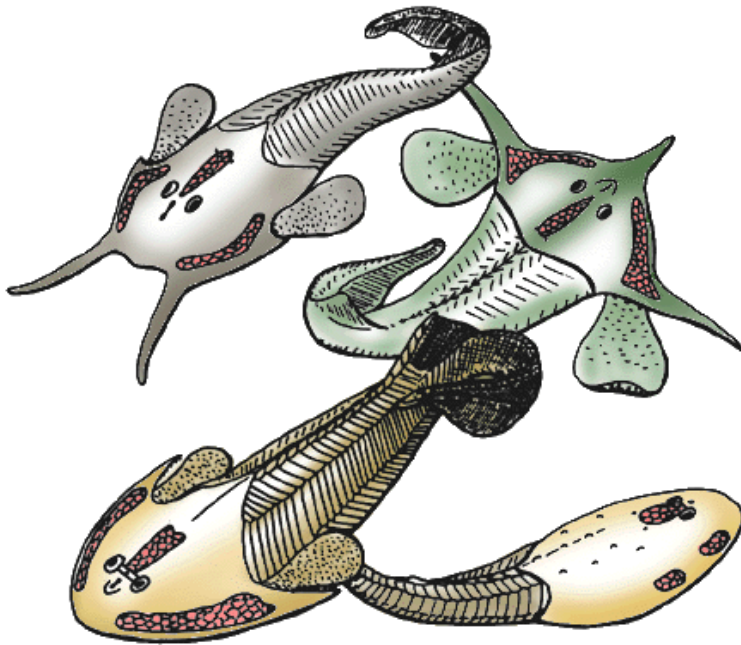
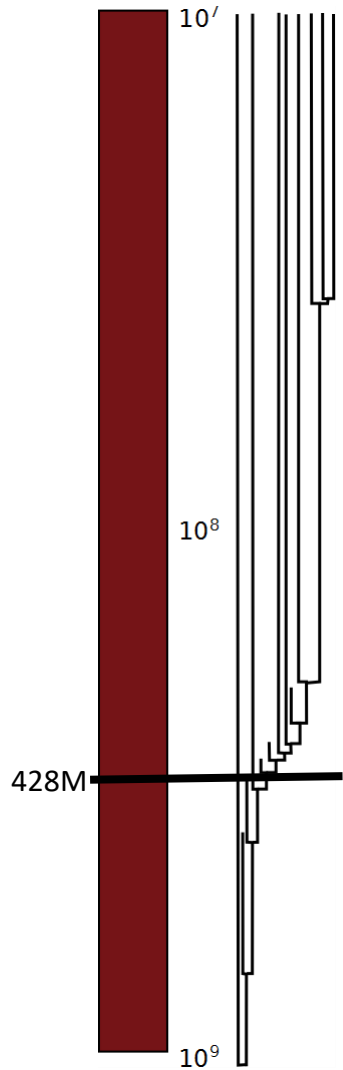
K.L. Feilich

Muscles and Little Else



K.L. Feilich

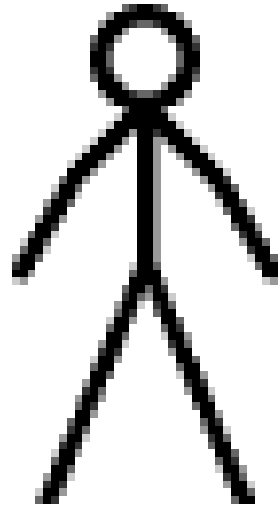
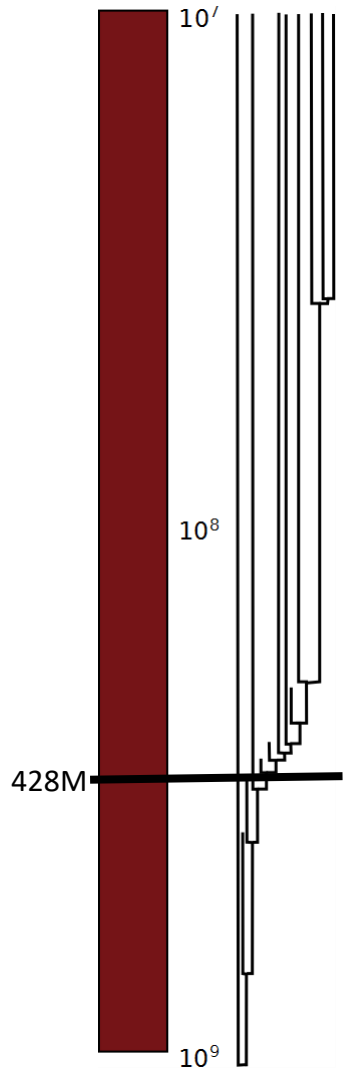
Bones Matter



Philippe Janvier/ CC BY 3.0

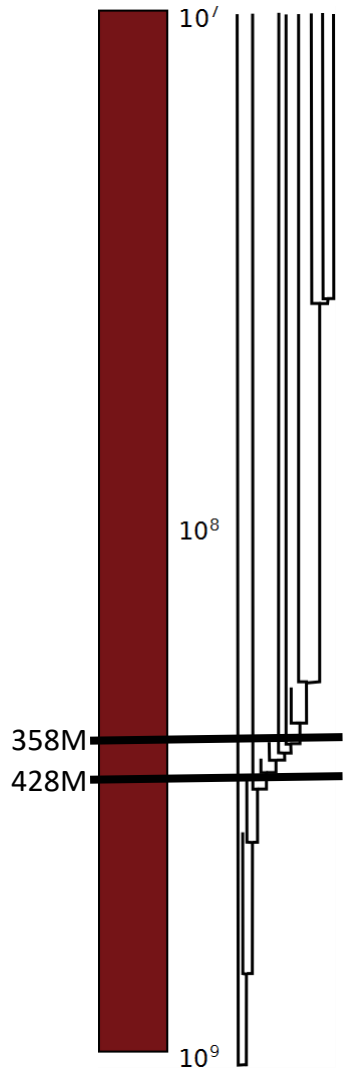


Bones Matter, and Let You Have Joints

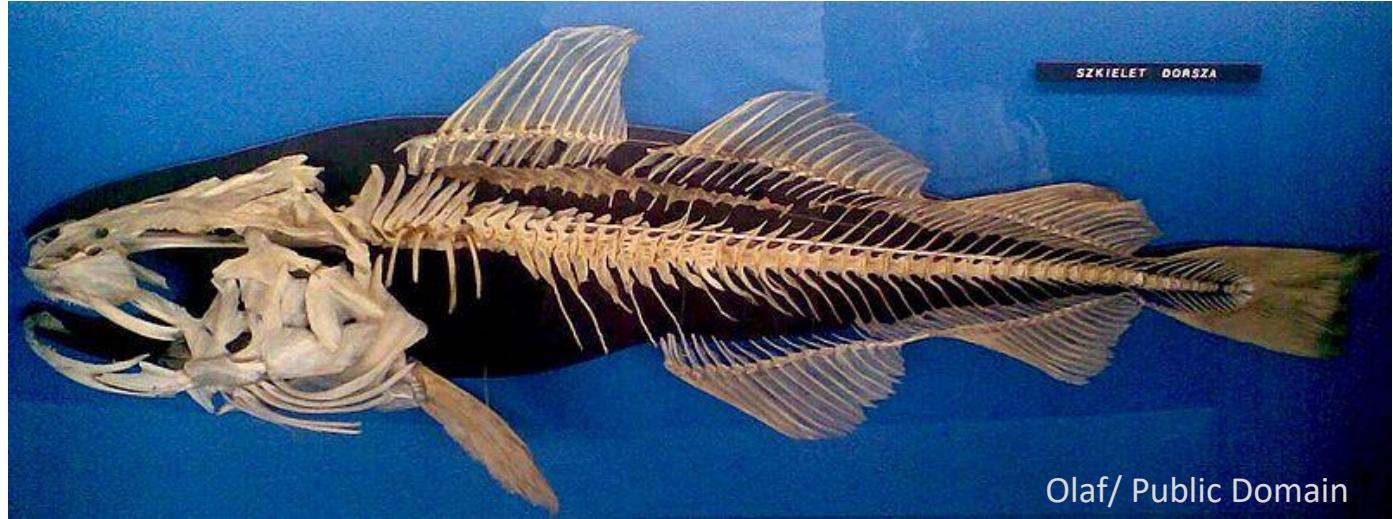
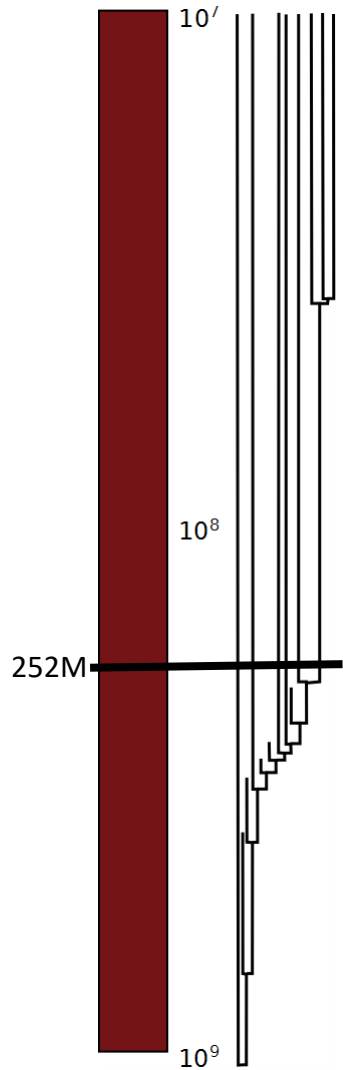


Pava/ Public Domain

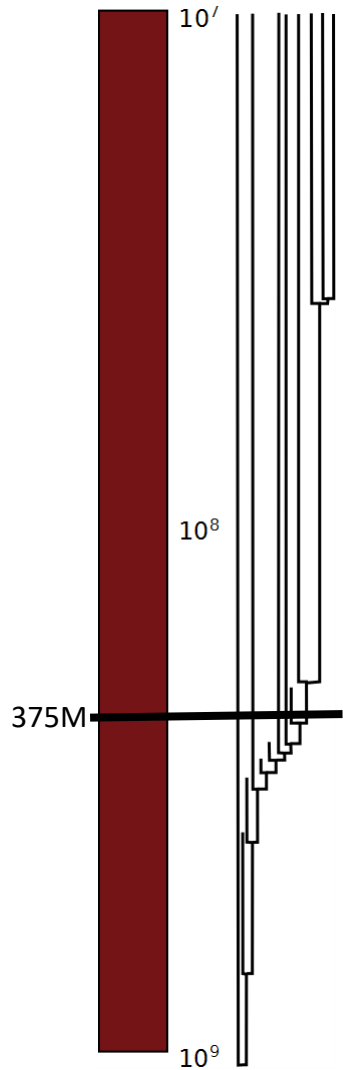
Paired Fins: The Body is No Longer the Only Motor



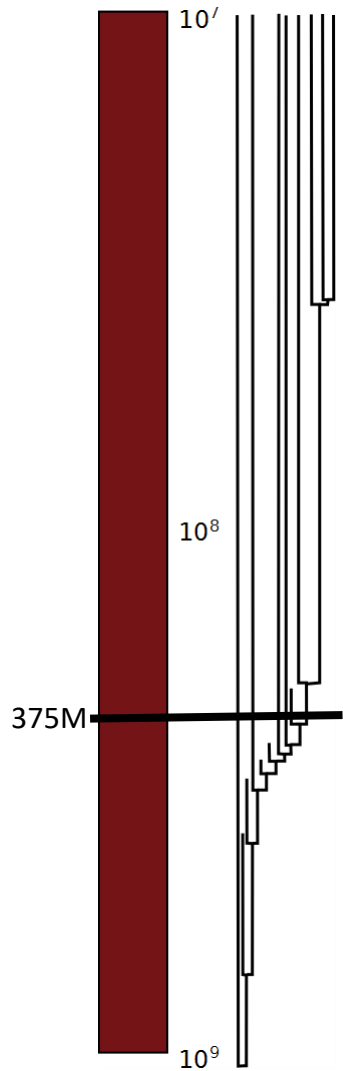
Teleosts: Lighter and Nimblar



Water's great, but land means WEIGHT

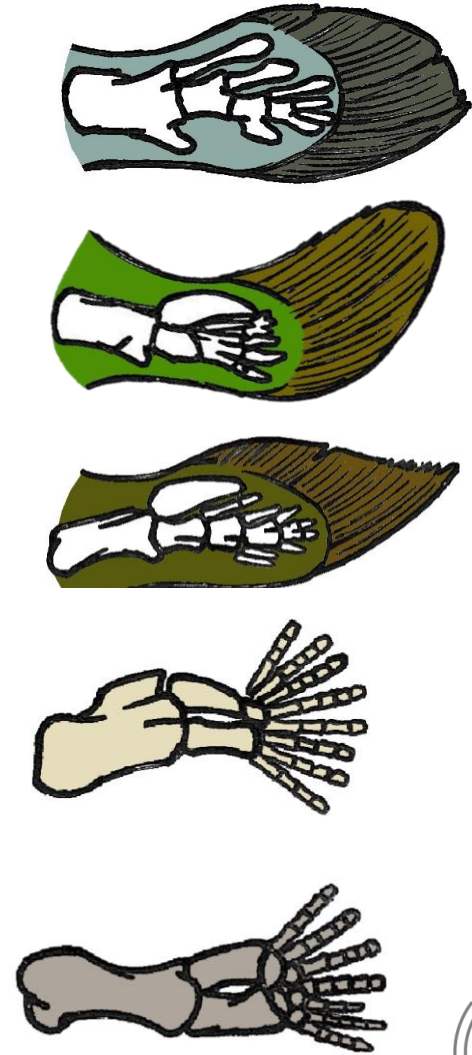
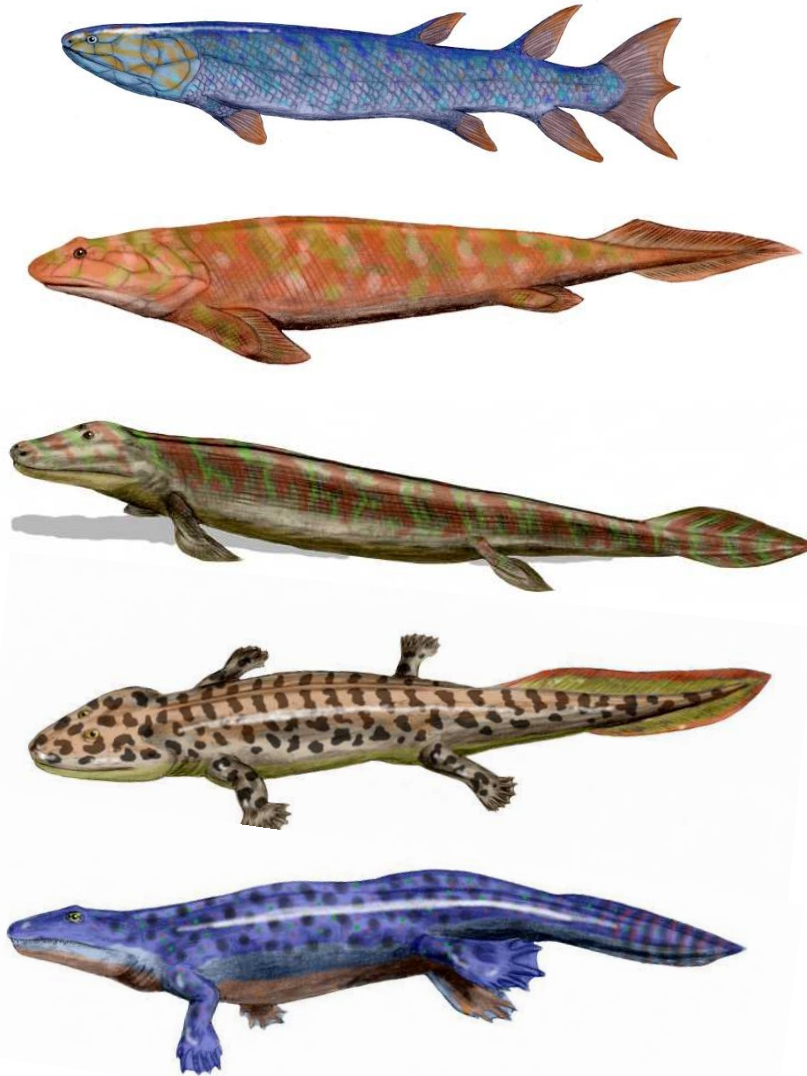
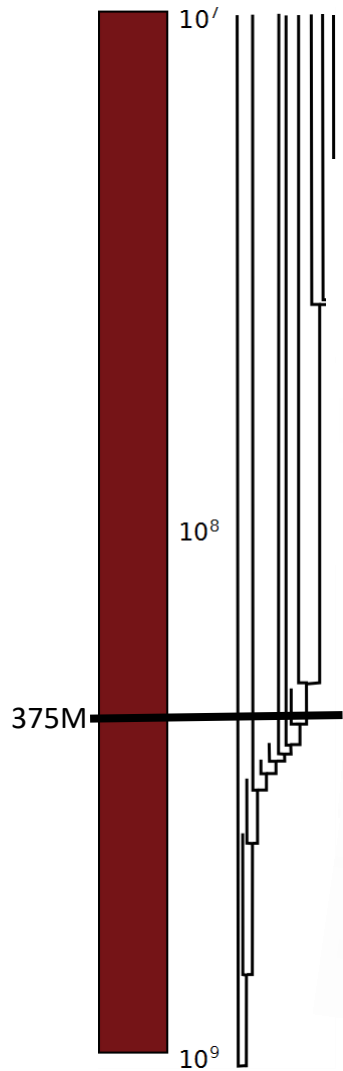


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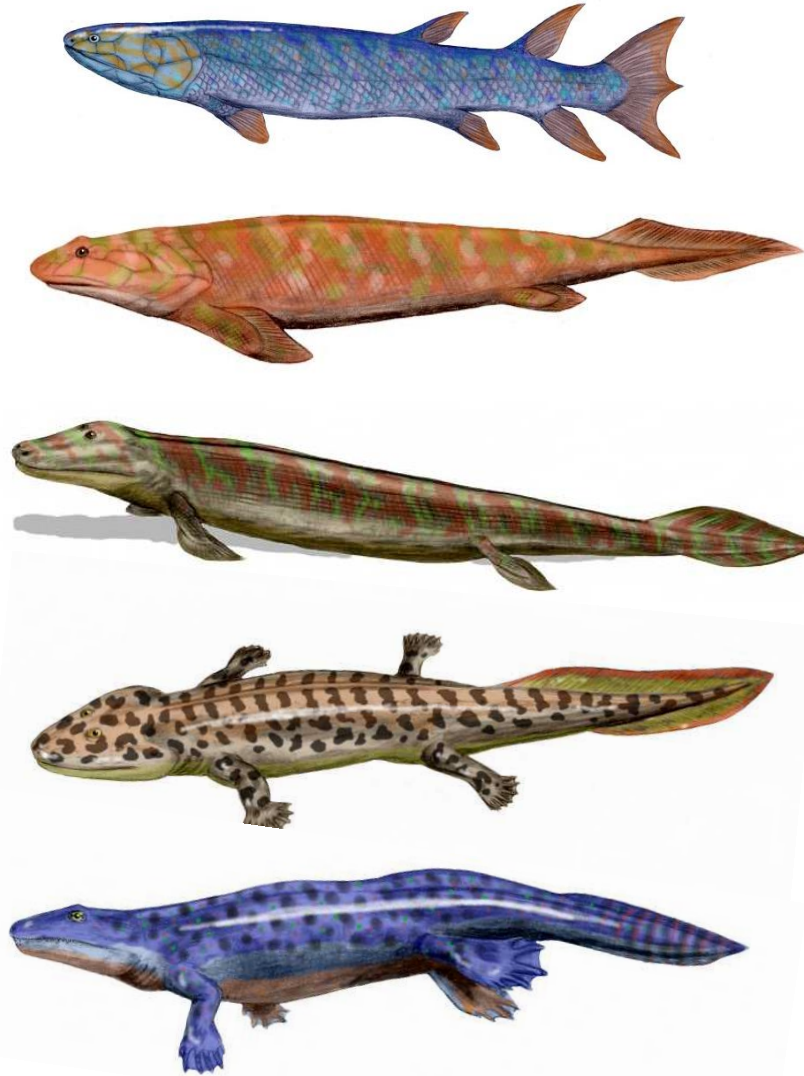
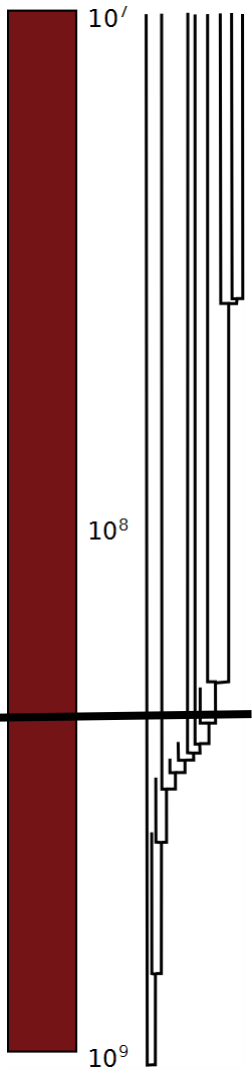


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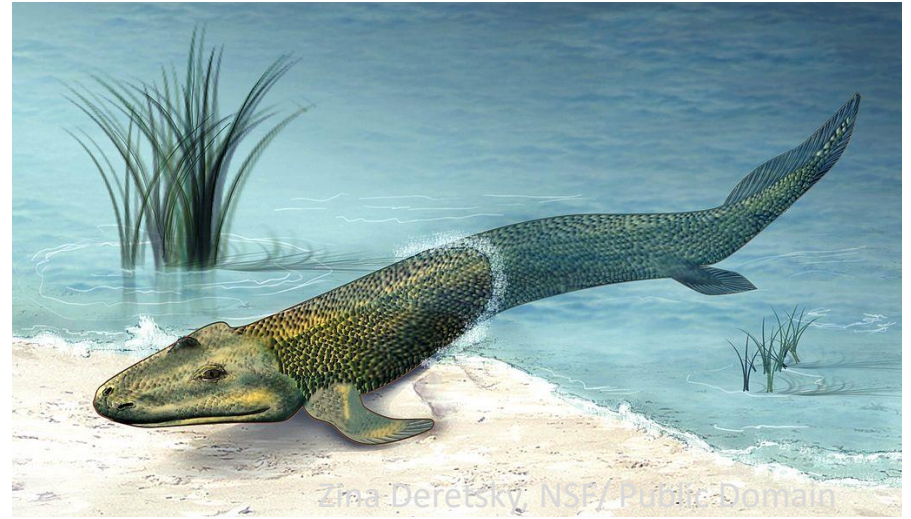
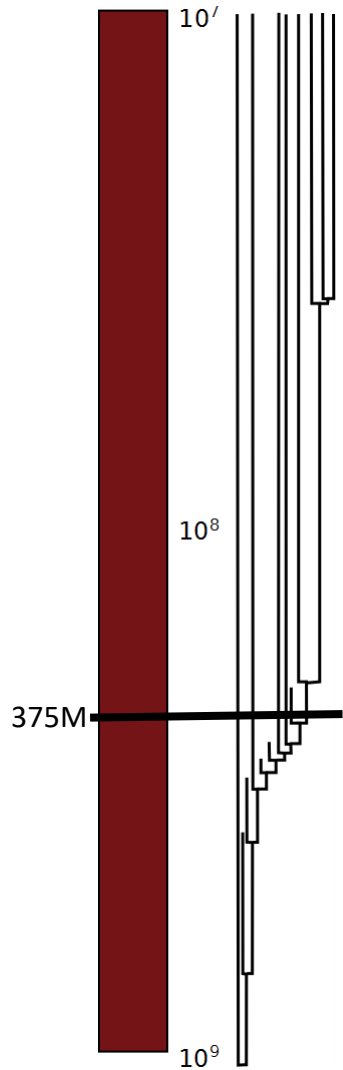
Limbs: A solution to Gravity



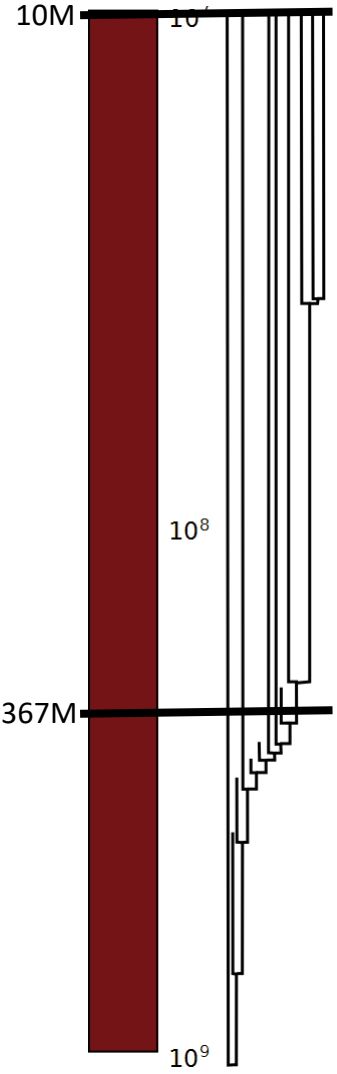
Necks: A Solution to Limbs



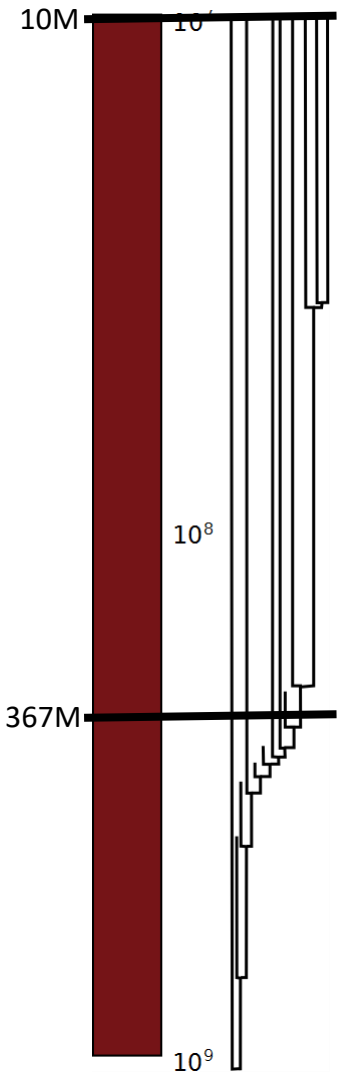
Tiktaalik



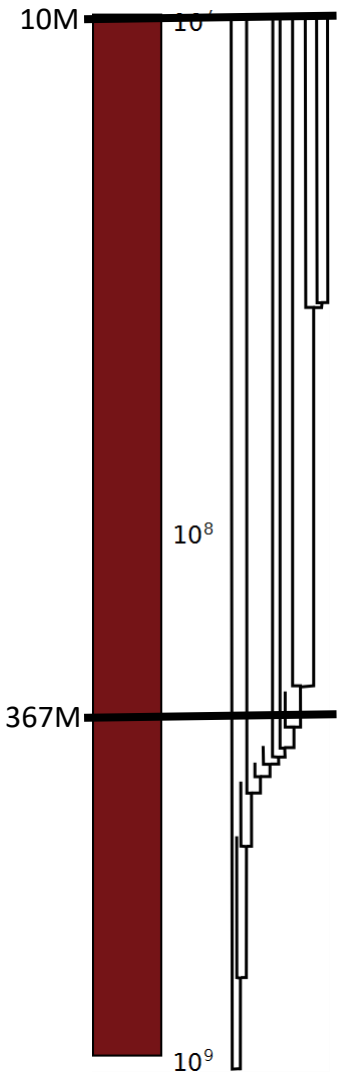
Improving a Fish Out of Water



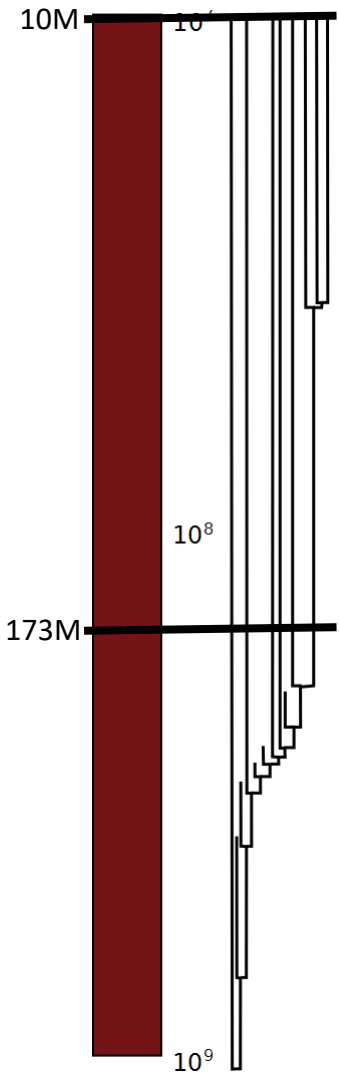
Bigger is Better (if you're more Upright)



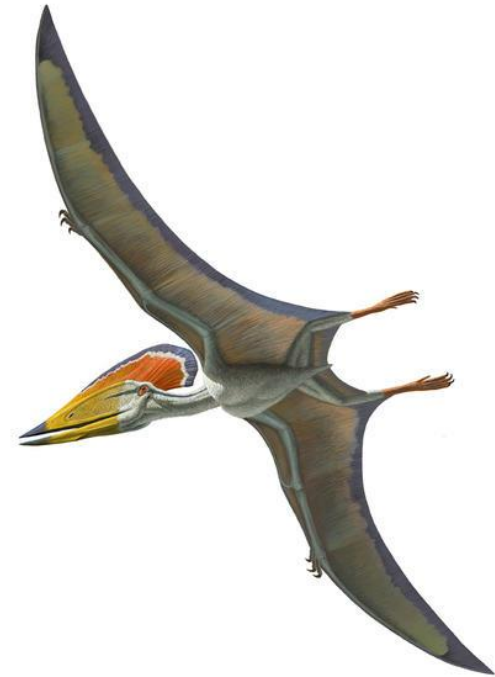
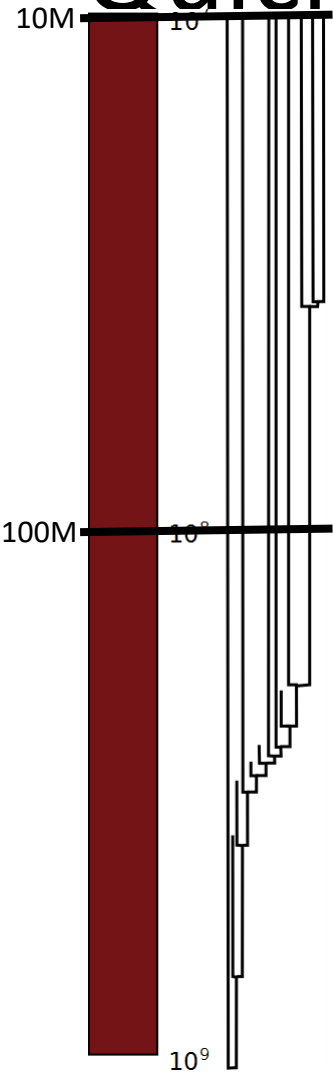
Tetrapod diversity



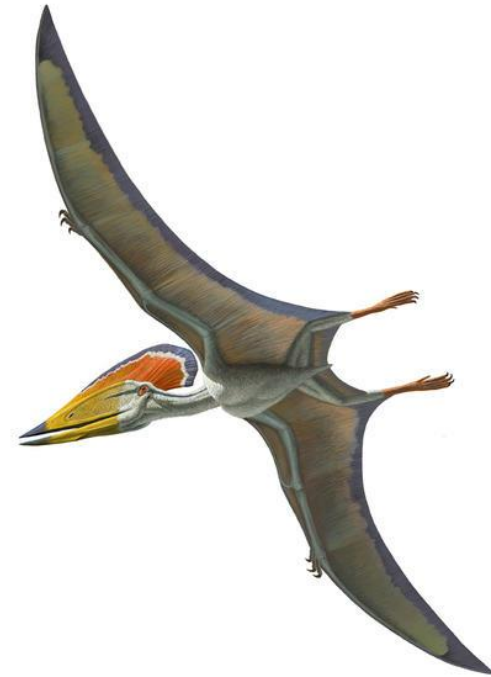
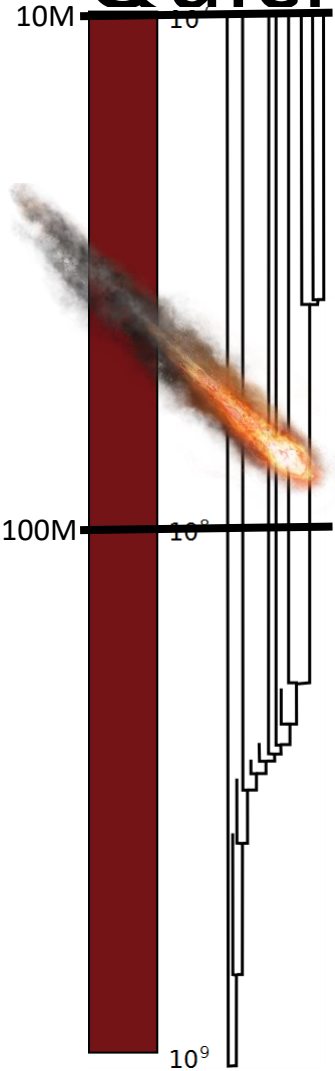
Mammals



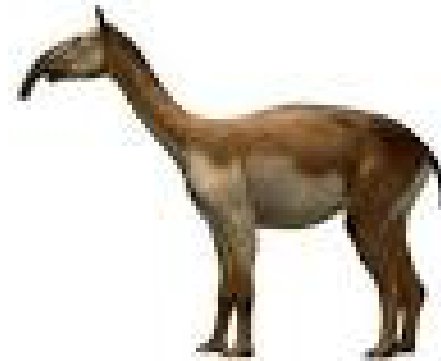
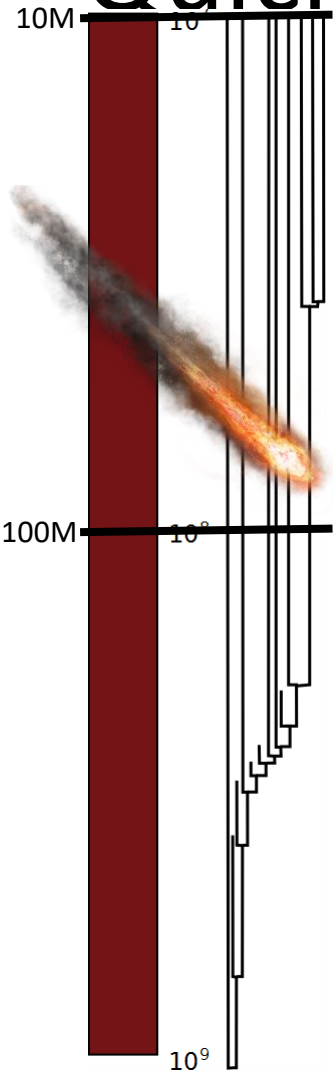
Quick Summary of 100-10 Million



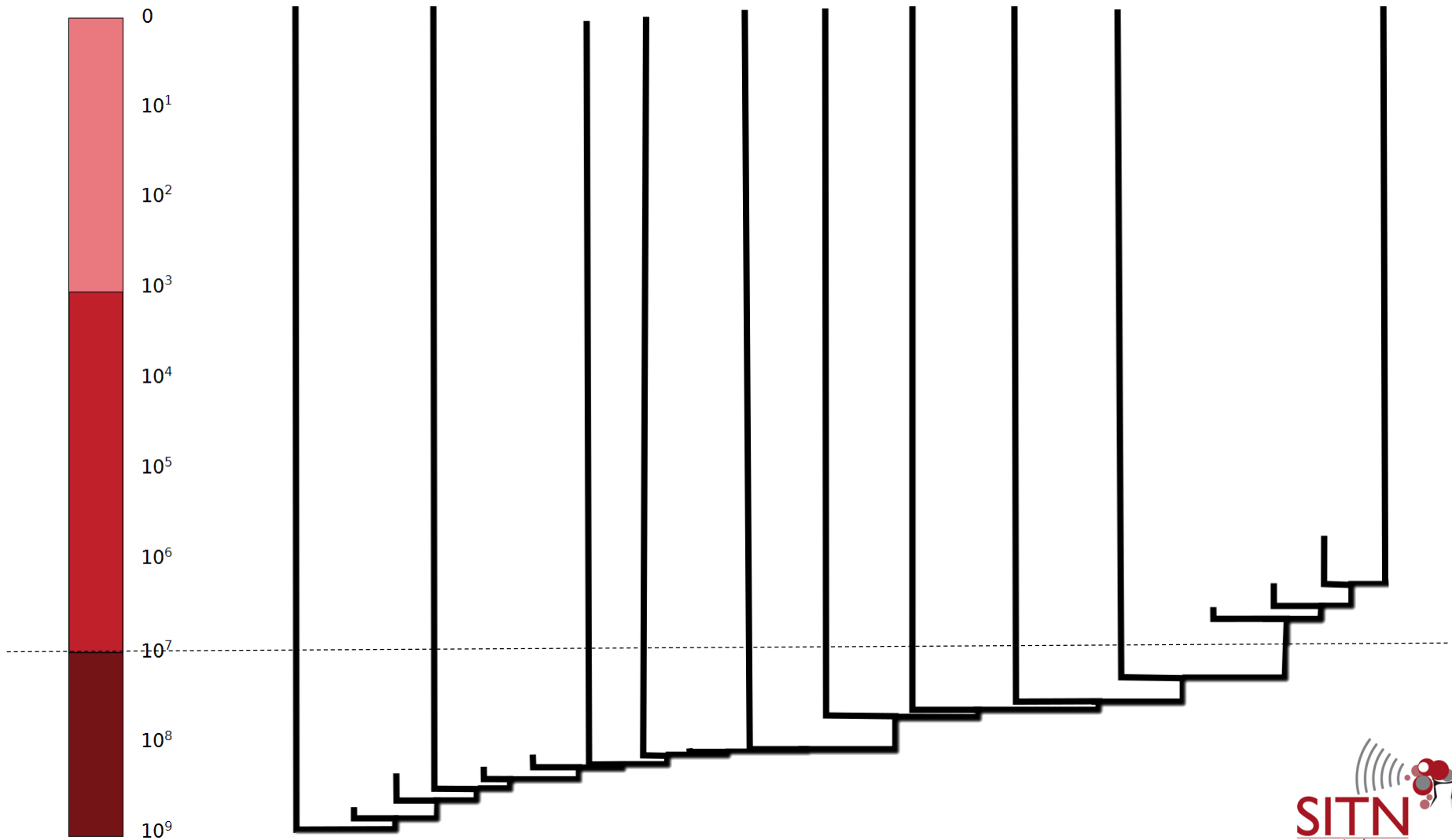
Quick Summary of 100-10 Million



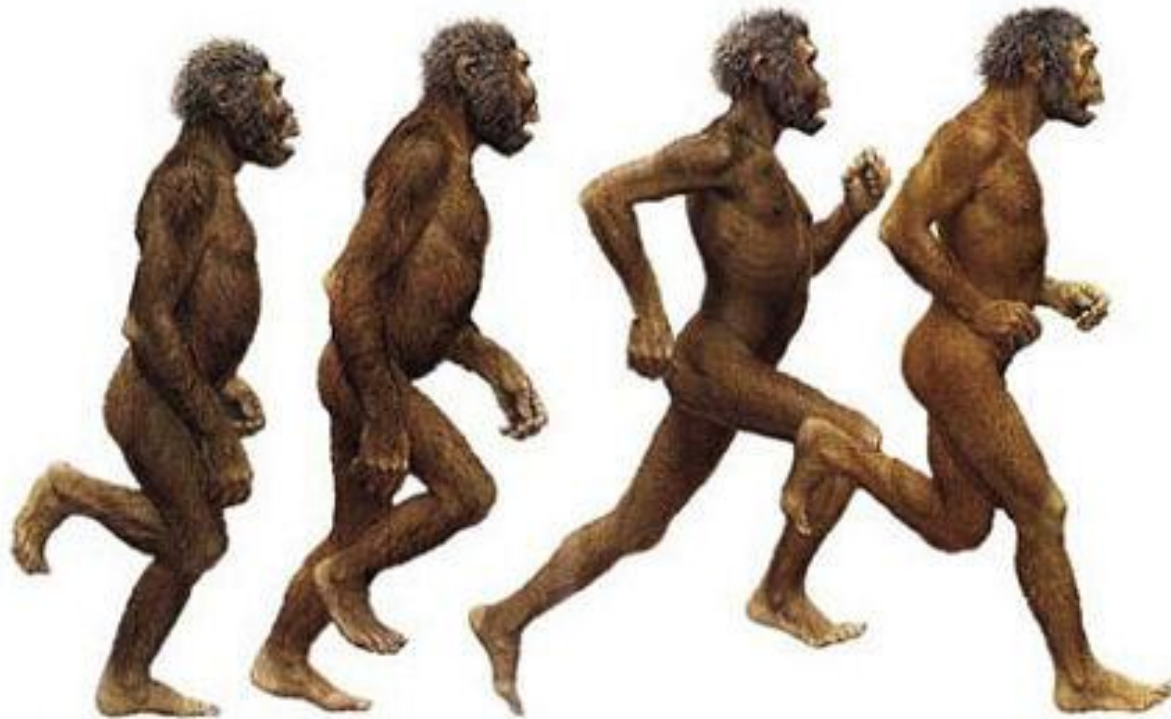
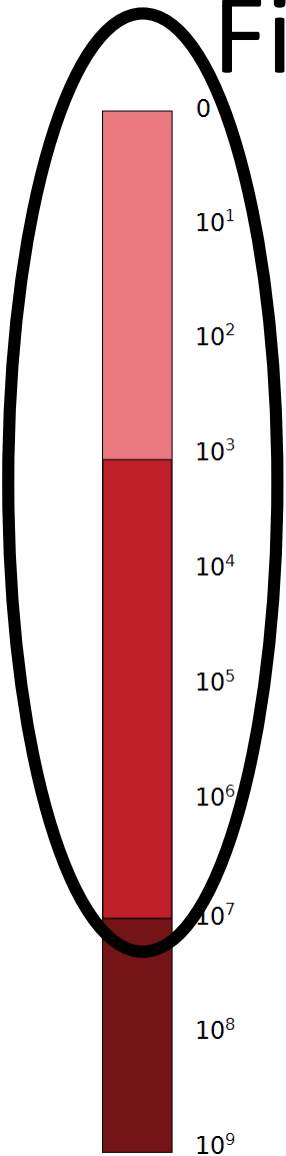
Quick Summary of 100-10 Million



Questions?



Finally, Humans and Ancestors



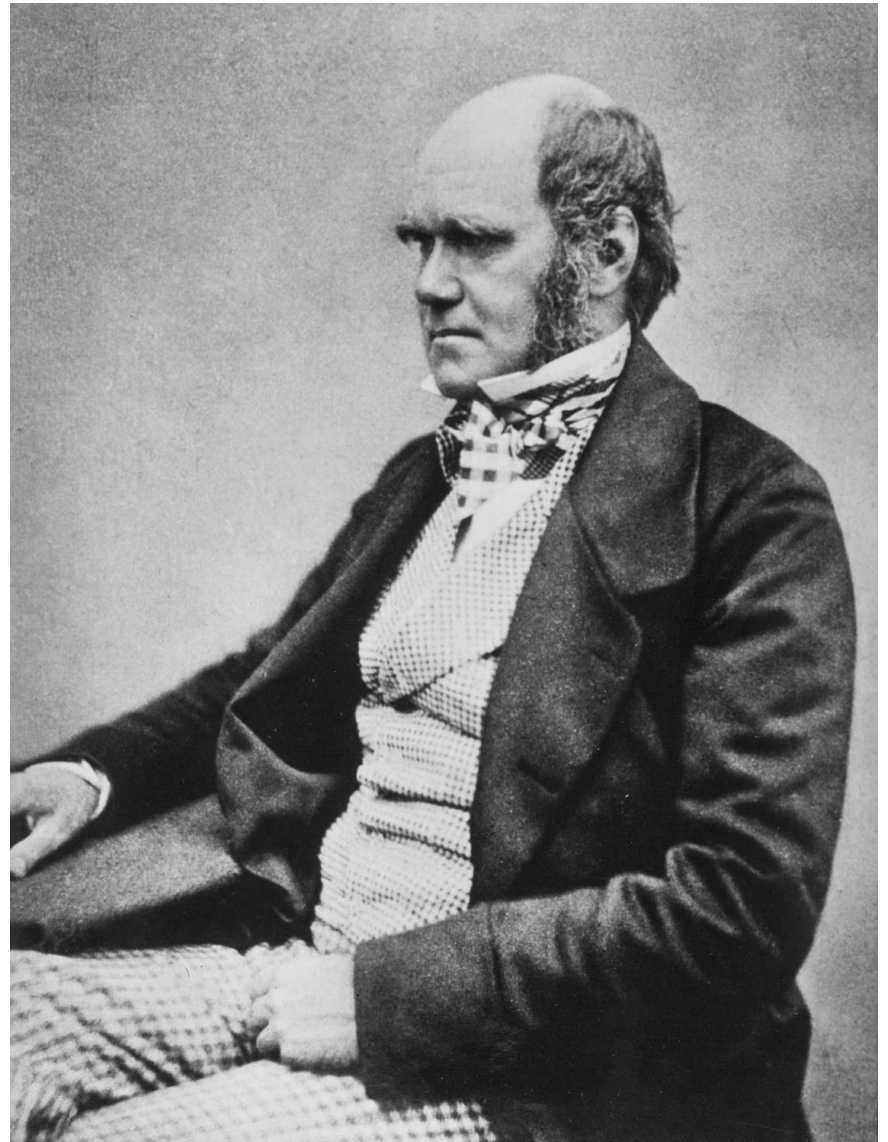
1859

Charles Darwin

On the Origin of Species

**“descent with
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**i.e. animals are related to
each other and descended
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1863

**Thomas Henry Huxley
(a.k.a. “Darwin’s
Bulldog”)**

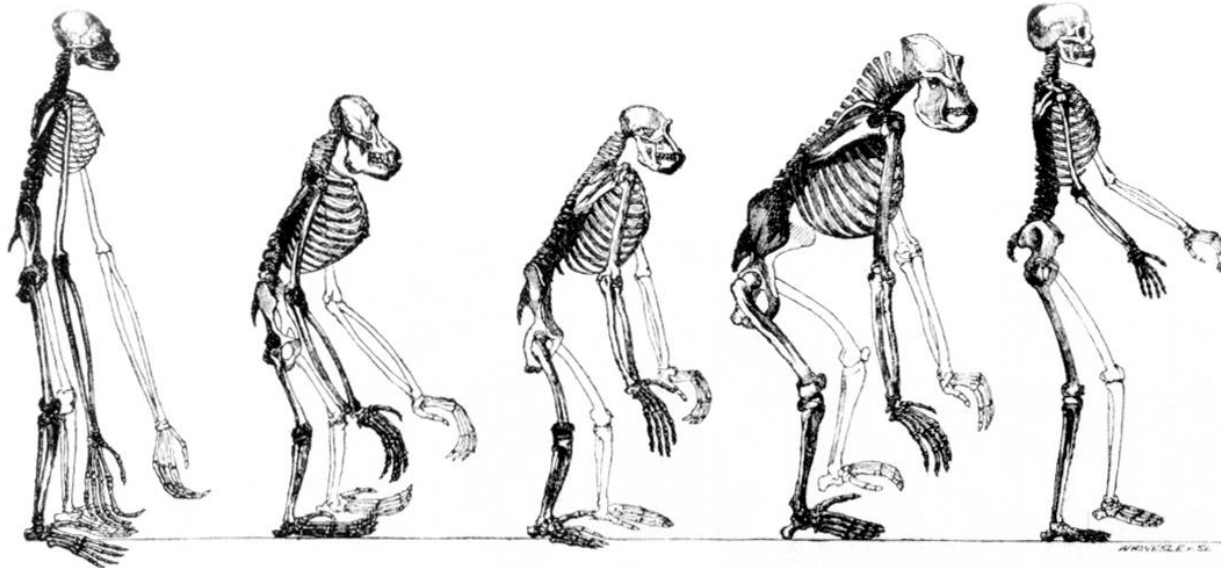
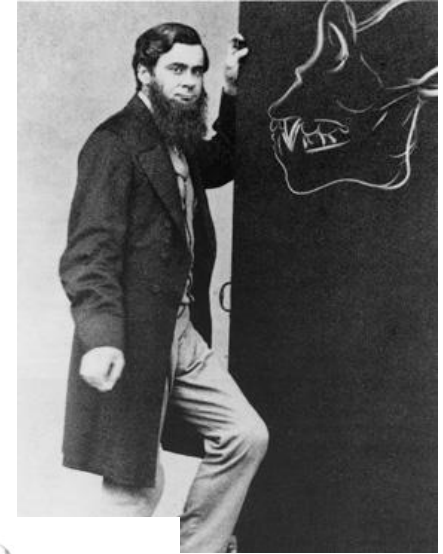
Man’s Place in Nature



1863

Thomas Henry Huxley
(a.k.a. "Darwin's Bulldog")

Man's Place in Nature



GIBBON.

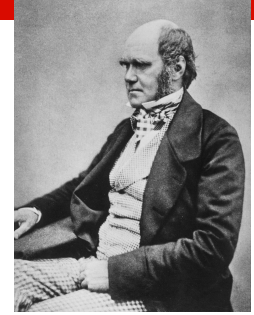
ORANG.

Skeletons of the
CHIMPANZEE.

GORILLA.

MAN.

*Photographically reduced from Diagrams of the natural size (except that of the Gibbon, which was twice as large as nature),
drawn by Mr. Waterhouse Hawkins from specimens in the Museum of the Royal College of Surgeons.*

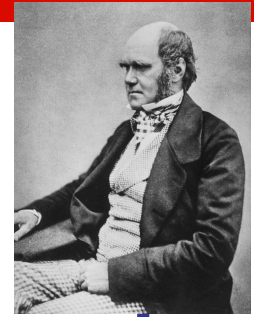


APES

intelligent
arboreal
quadrupedal

HUMANS

very intelligent
terrestrial
bipedal

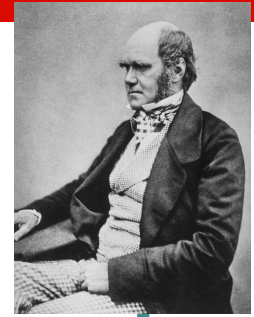


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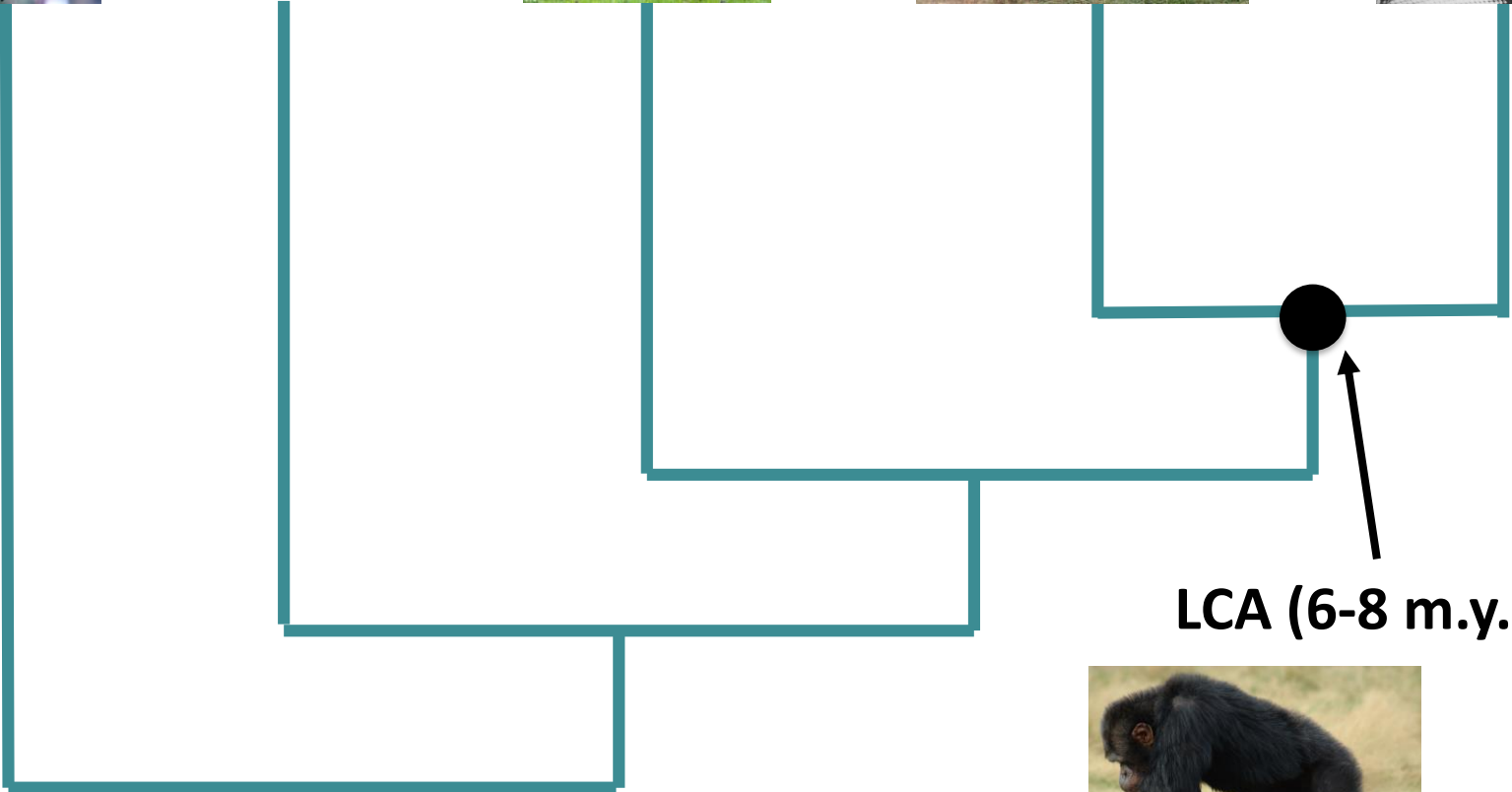
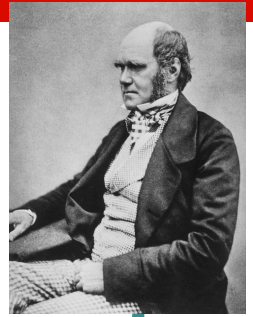


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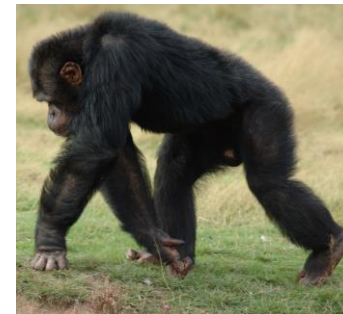
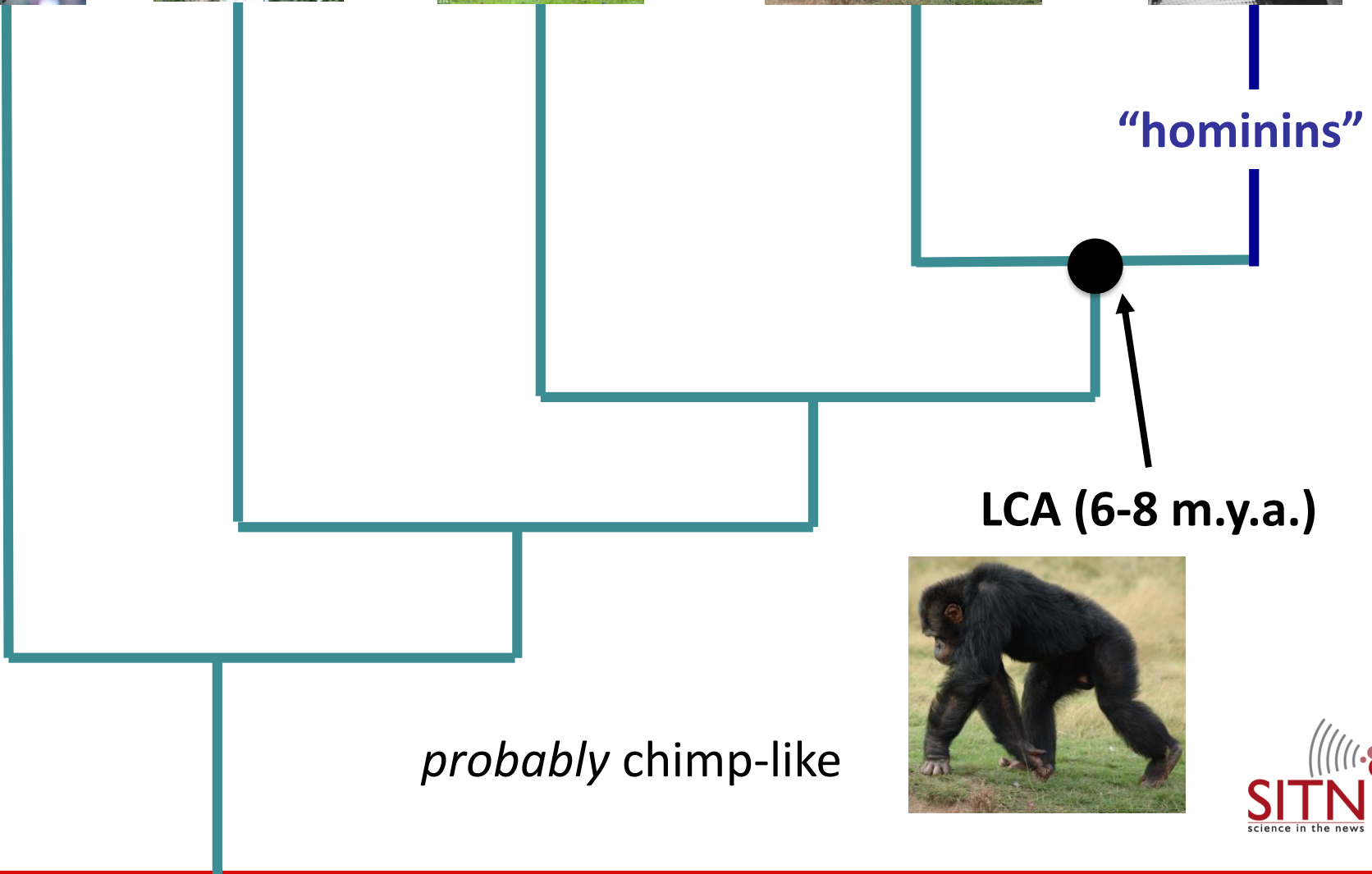
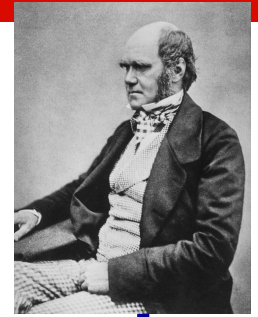
HUMANS

very intelligent
terrestrial
bipedal



probably chimp-like





What is the defining characteristic of
hominins?

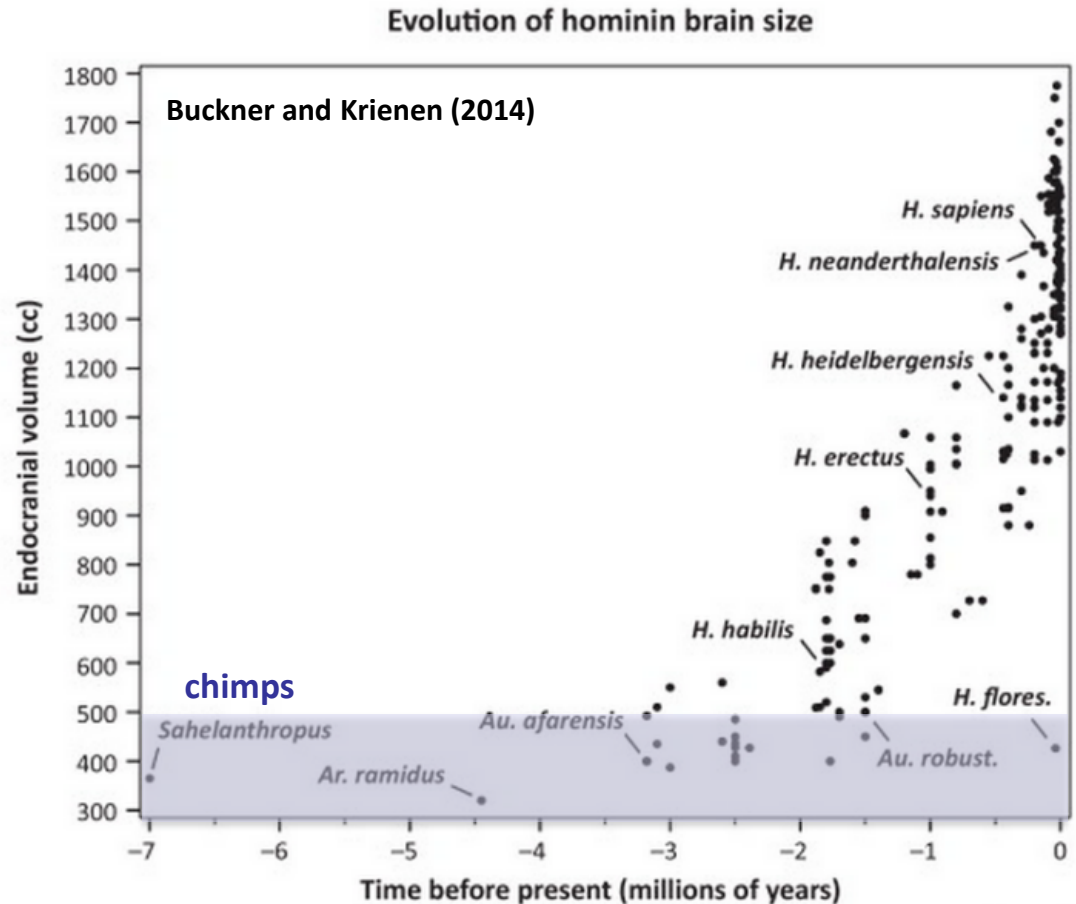
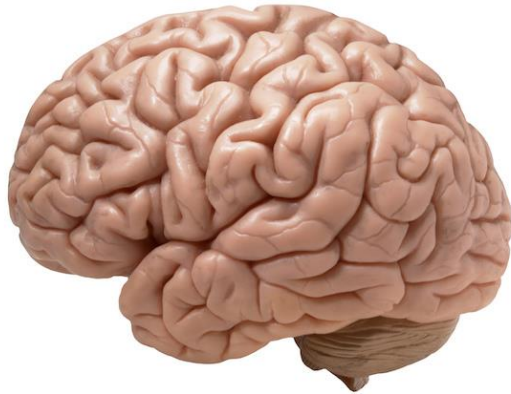
What is the defining characteristic of
hominins?

Brain Size?



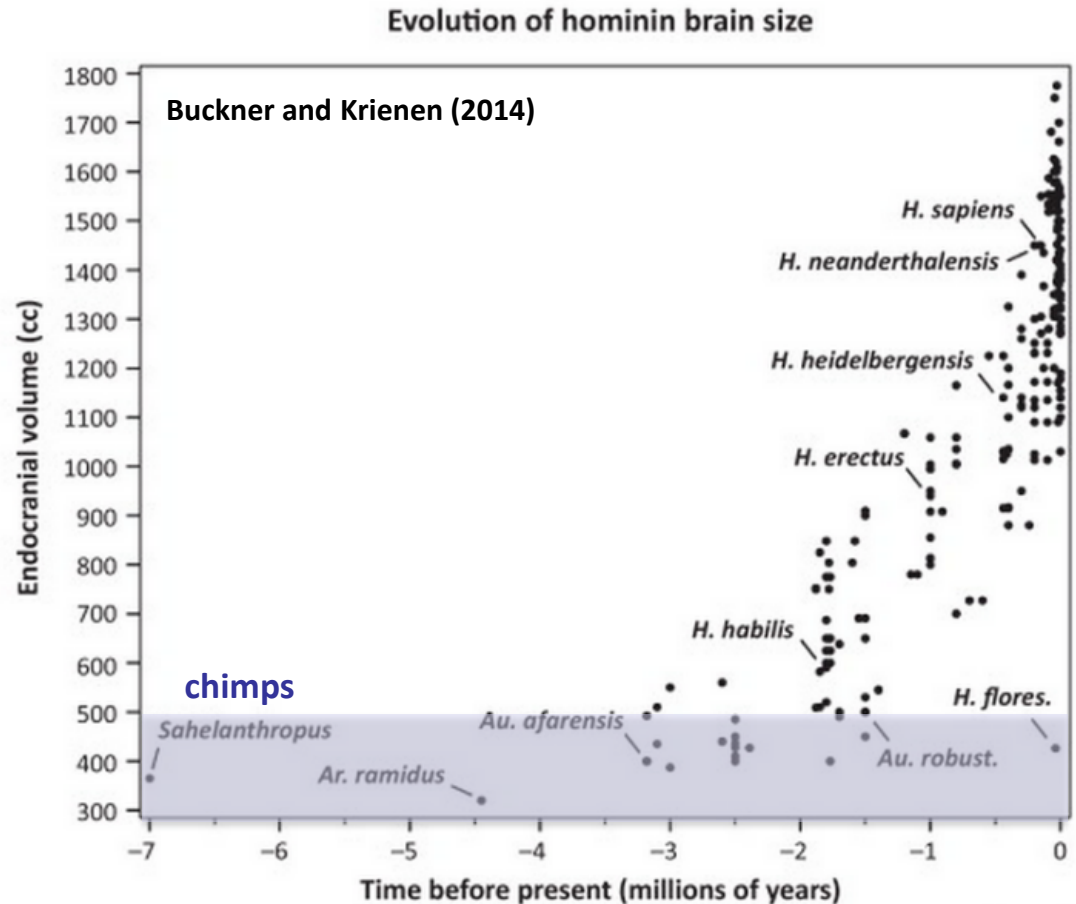
What is the defining characteristic of hominins?

Brain Size?



What is the defining characteristic of hominins?

Brain Size?



NOPE

What is the defining characteristic of
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Terrestrialism?



What is the defining characteristic of hominins?

Terrestrialism?



What is the defining characteristic of
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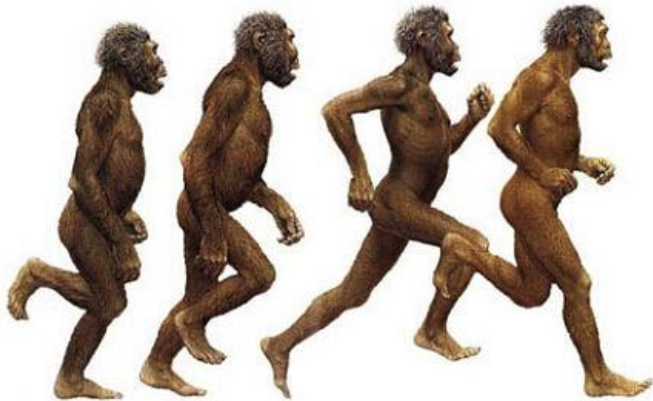
Terrestrialism?



NOPE

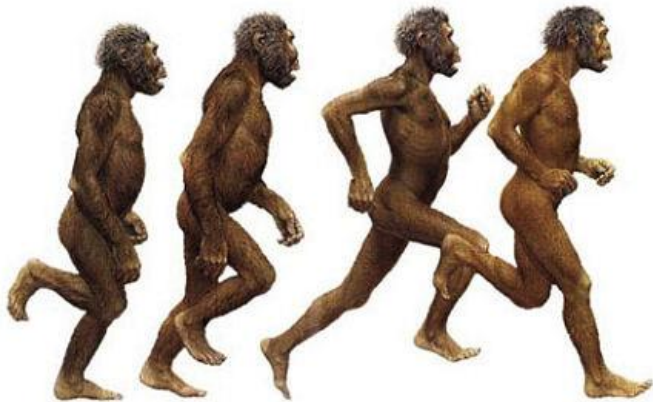
What is the defining characteristic of
hominins?

Bipedalism?

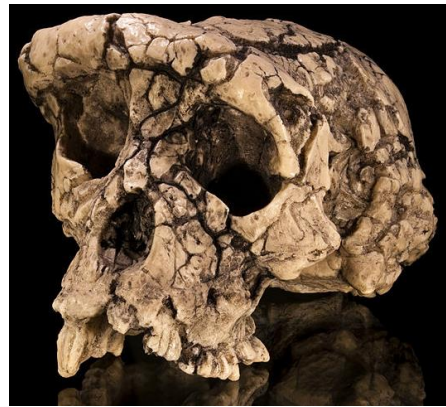


What is the defining characteristic of hominins?

Bipedalism?



Sahelanthropus
(7 m.y.a.)



Orrorin
(6 m.y.a.)

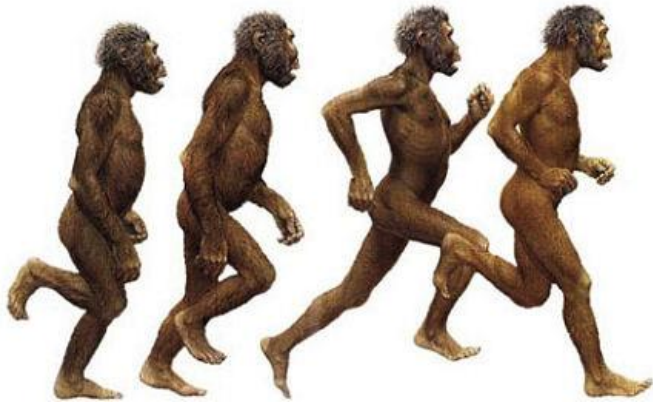


Ardipithecus
(4.4 m.y.a.)

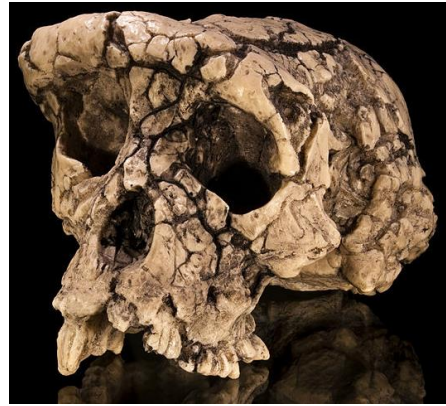


What is the defining characteristic of hominins?

Bipedalism?



Sahelanthropus
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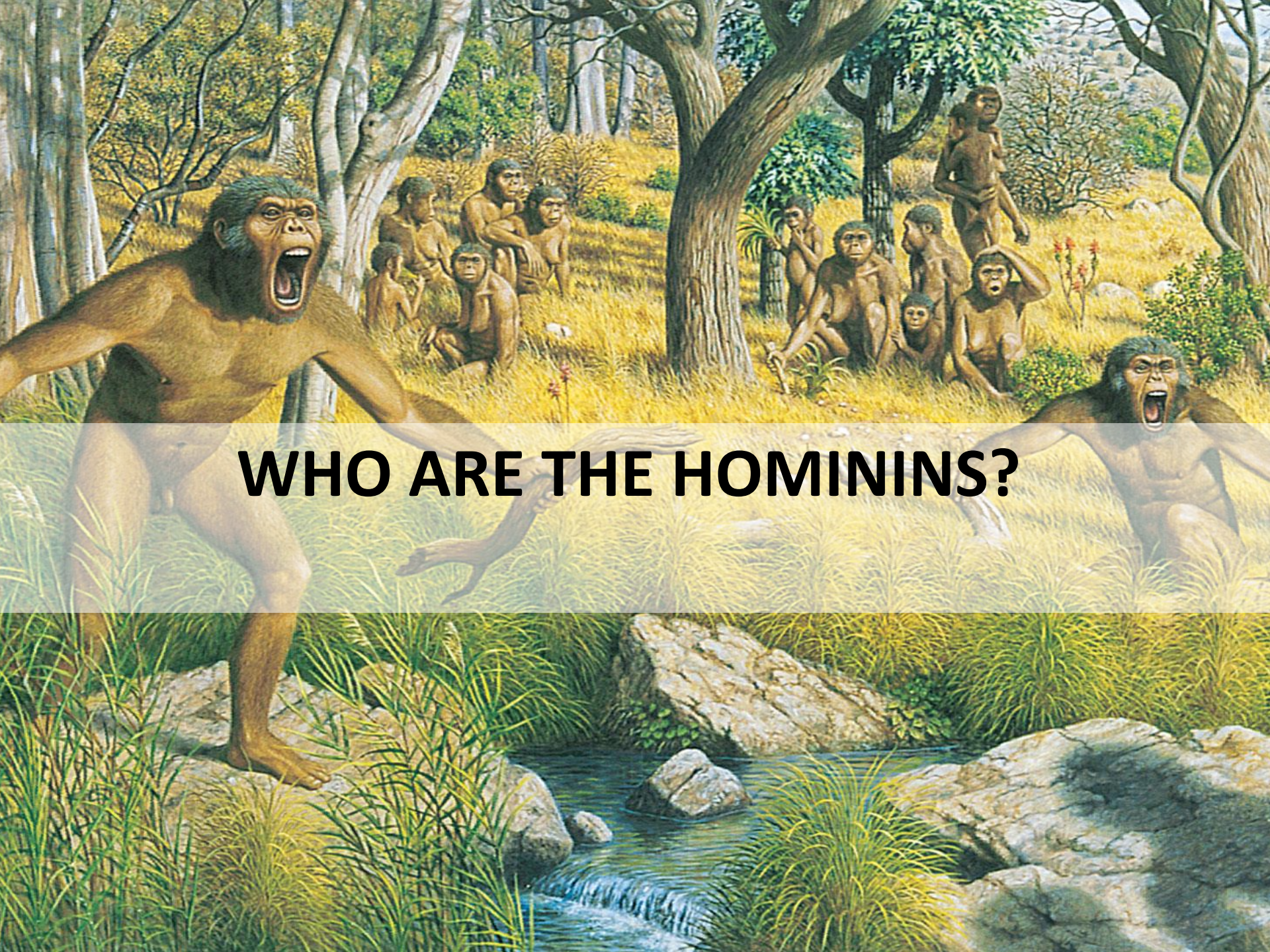
Orrorin
(6 m.y.a.)



Ardipithecus
(4.4 m.y.a.)



YES!



WHO ARE THE HOMININS?





Early Hominins

7 – 4 m.y.a.





Early Hominins

7 – 4 m.y.a.

The Australopiths

4 – 2 m.y.a.



Early Hominins

7 – 4 m.y.a.



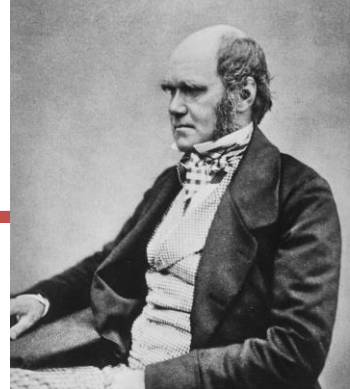
The Australopiths

4 – 2 m.y.a.



Homo

3 m.y.a. – pr.



So why are hominins bipedal?

So why are hominins bipedal?



Aquatic Ape Hypothesis

So why are hominins bipedal?



aquatic Ape Hypothesis

So why are hominins bipedal?



Tall Grass Hypothesis

So why are hominins bipedal?



all Grass Hypothesis

So why are hominins bipedal?



Pugilist Hypothesis

So why are hominins bipedal?



Pugilist Hypothesis

So why are hominins bipedal?



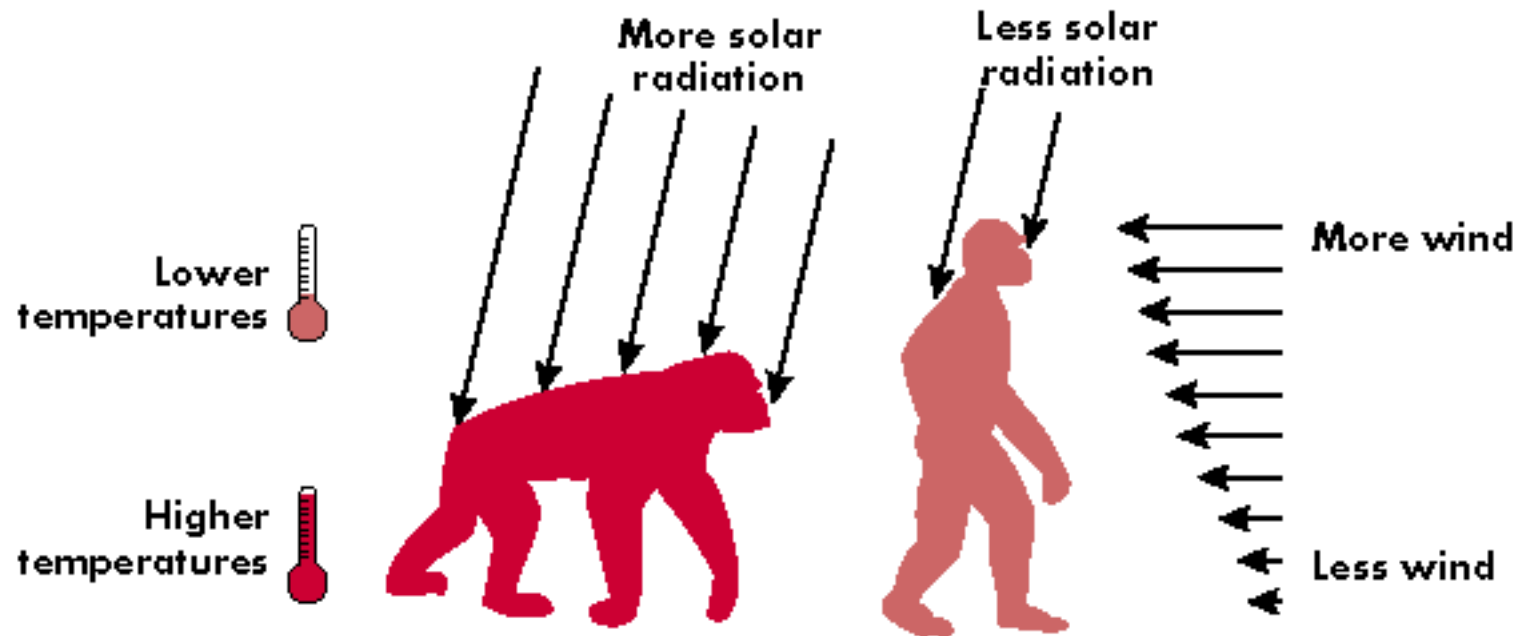
Carrying Hypothesis

So why are hominins bipedal?



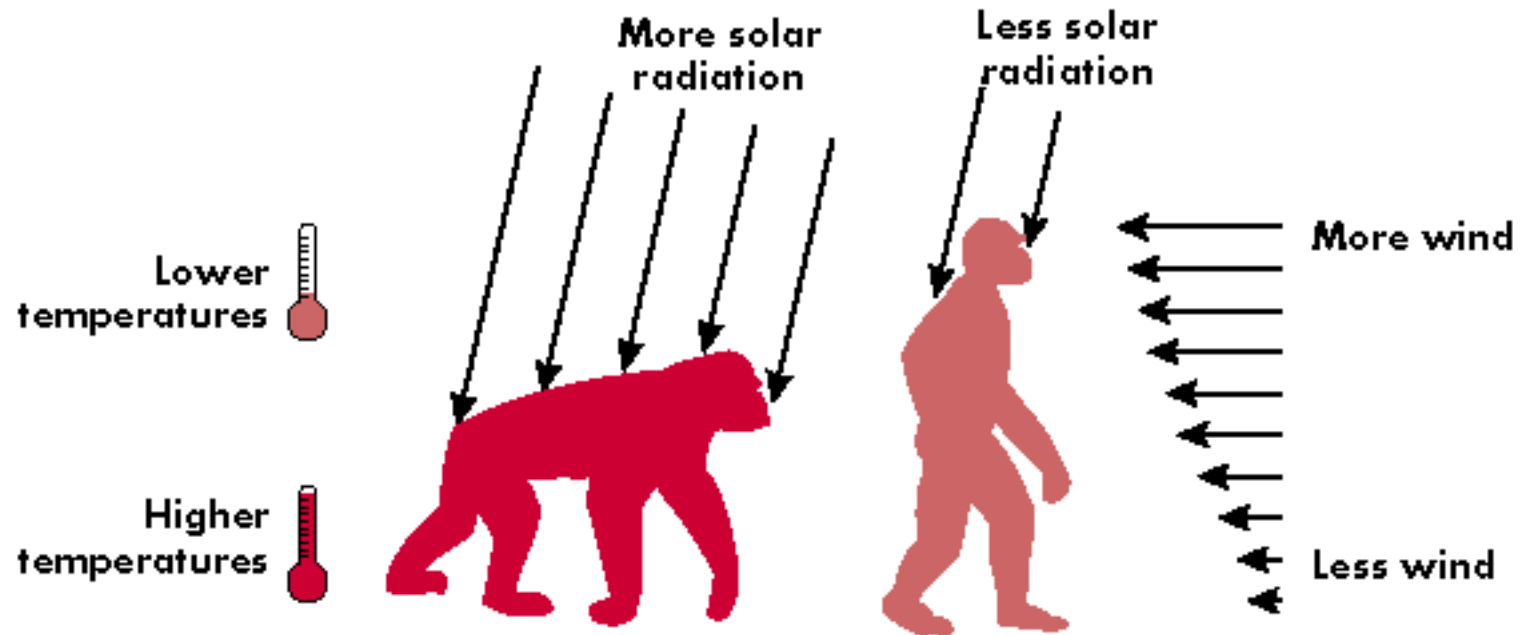
Carrying Hypothesis

So why are hominins bipedal?



Thermoregulatory Hypothesis

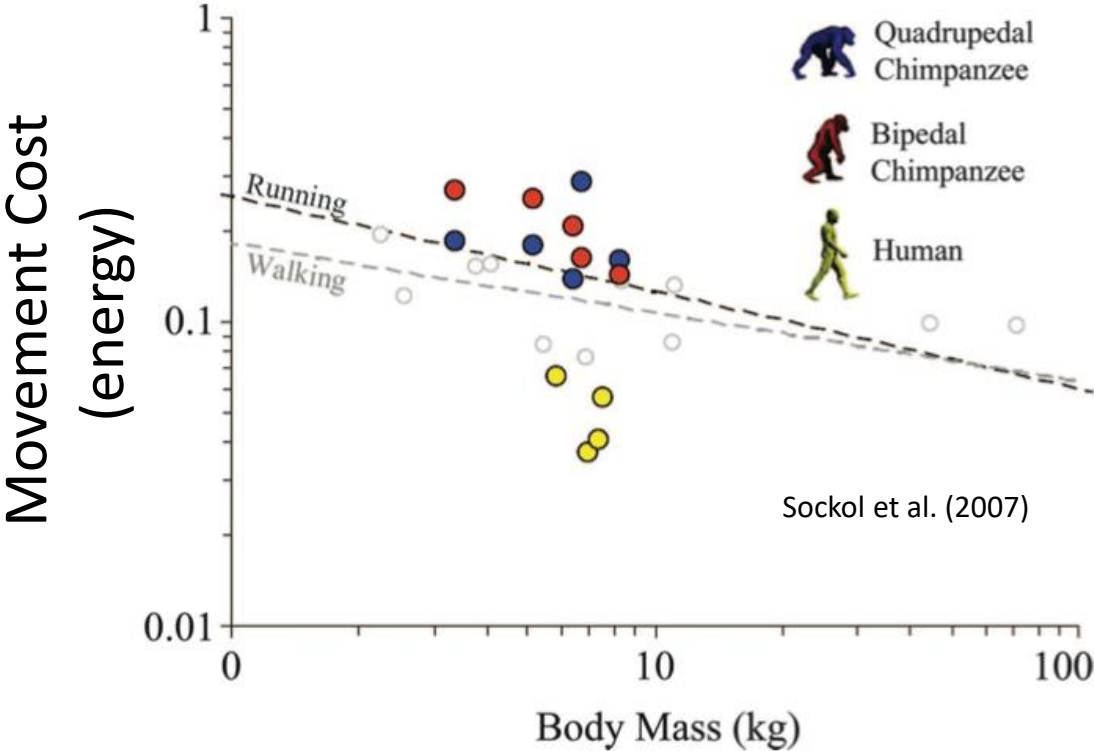
So why are hominins bipedal?



Thermoregulatory Hypothesis

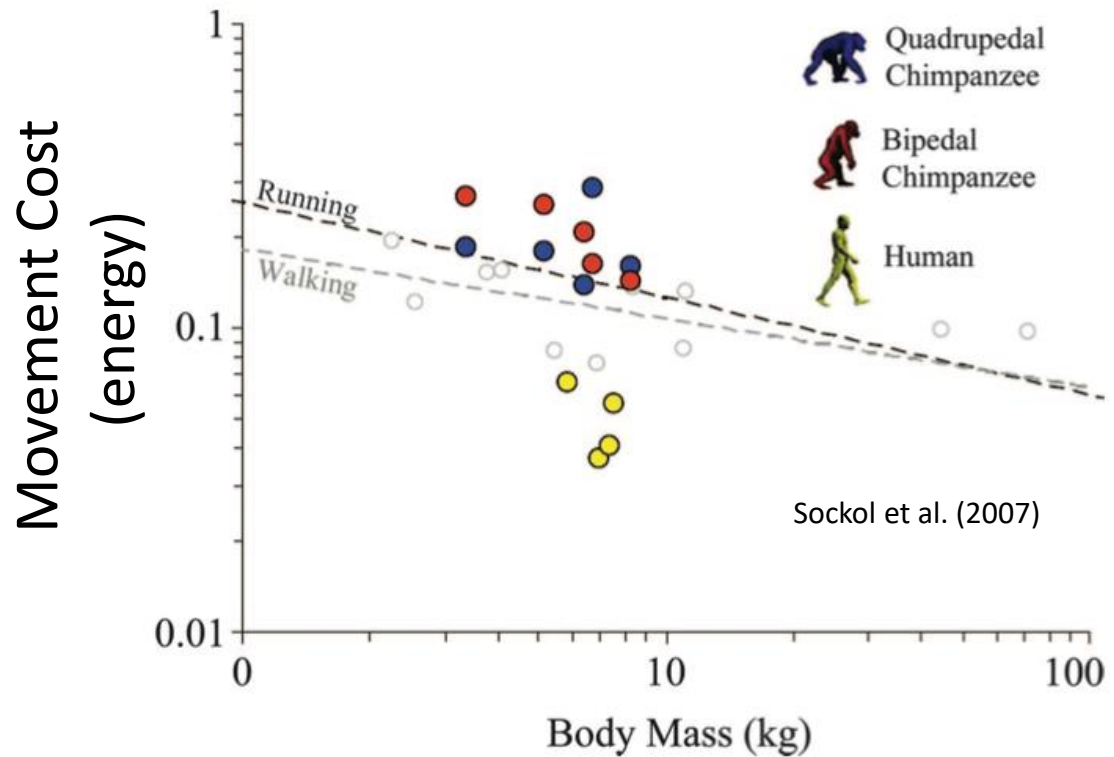
Maybe?

So why are hominins bipedal?

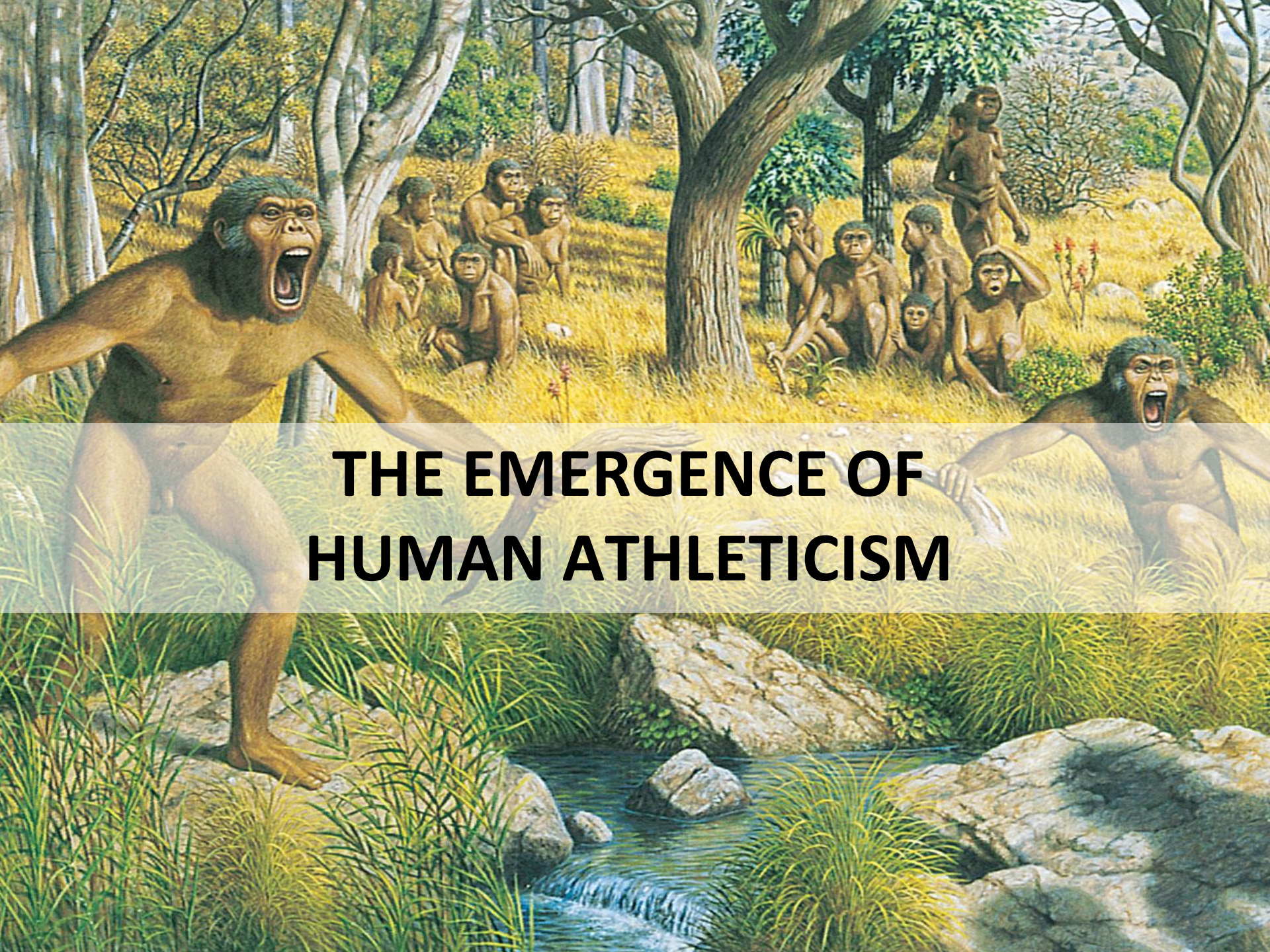


Energetic Hypothesis

So why are hominins bipedal?



Energetic Hypothesis
Pretty well supported



THE EMERGENCE OF HUMAN ATHLETICISM

Human Athleticism



STRENGTH



SPEED

Human Athleticism



STRENGTH

We are not very strong...



SPEED

...or very fast!

Human Athleticism

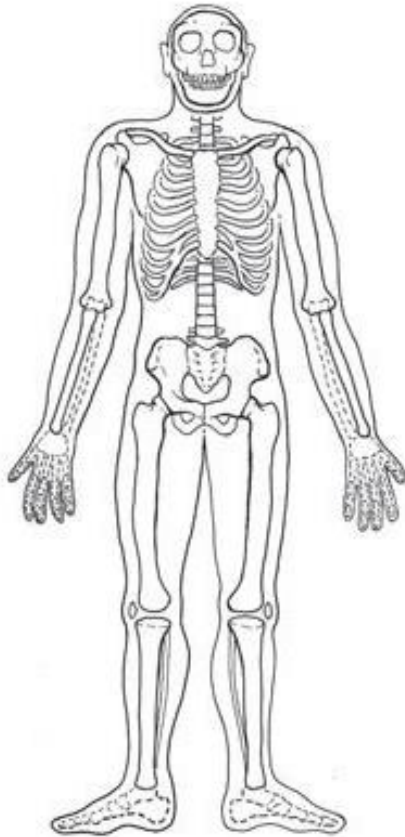


We are very good at endurance activity

Homo erectus: The Endurance Runner



Homo erectus marked the emergence of the hunter-gatherer lifestyle



Homo erectus

2.5-0.5 mya

The first fully human body

- Long legs
- Short arms
- Gracile body form
- Balanced head
- Stiff foot
- Large tendons

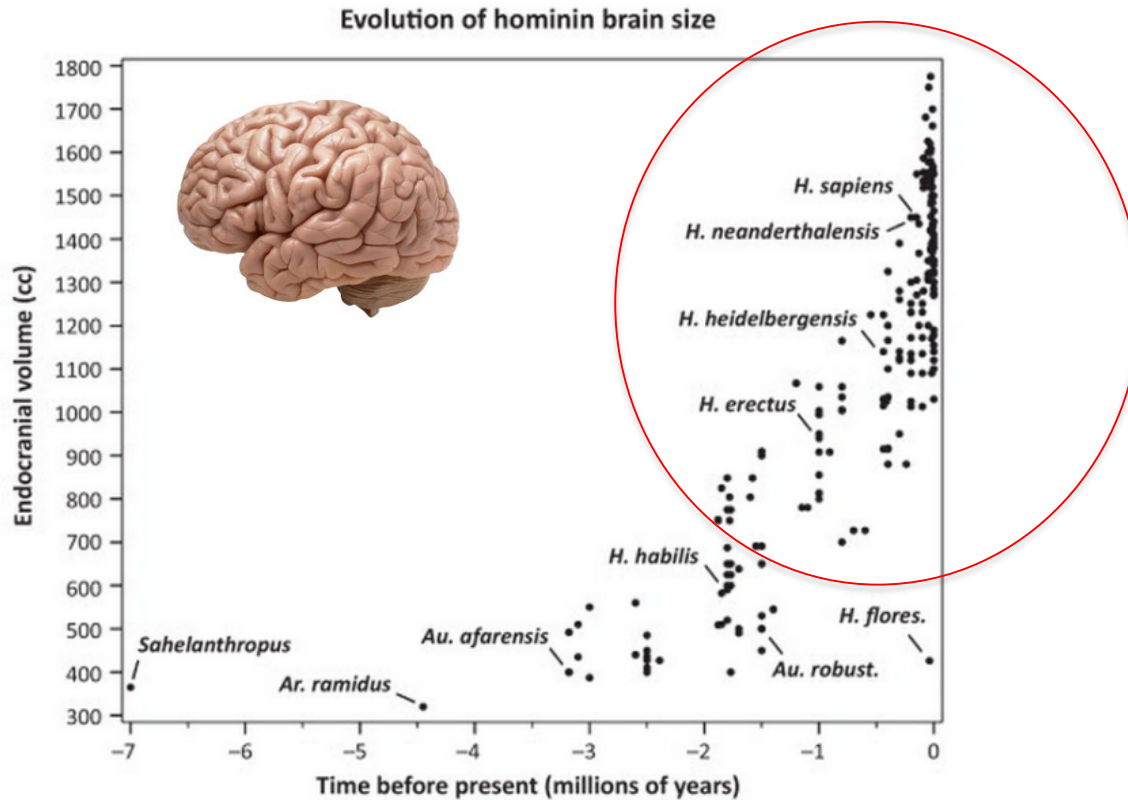
**ALL ADAPTATIONS
FOR RUNNING**

Homo erectus: The Endurance Runner



The ability to run prey to exhaustion allowed meat to become part of the diet...

Human Athleticism



...and allowed for expansion of the energetically expensive brain

Human Athleticism

Women: ~25% body fat



Men: ~15% body fat



One consequence: humans are very fat!

Human Athleticism

Chimp: ~2% body fat



Men: ~15% body fat



Women: ~25% body fat



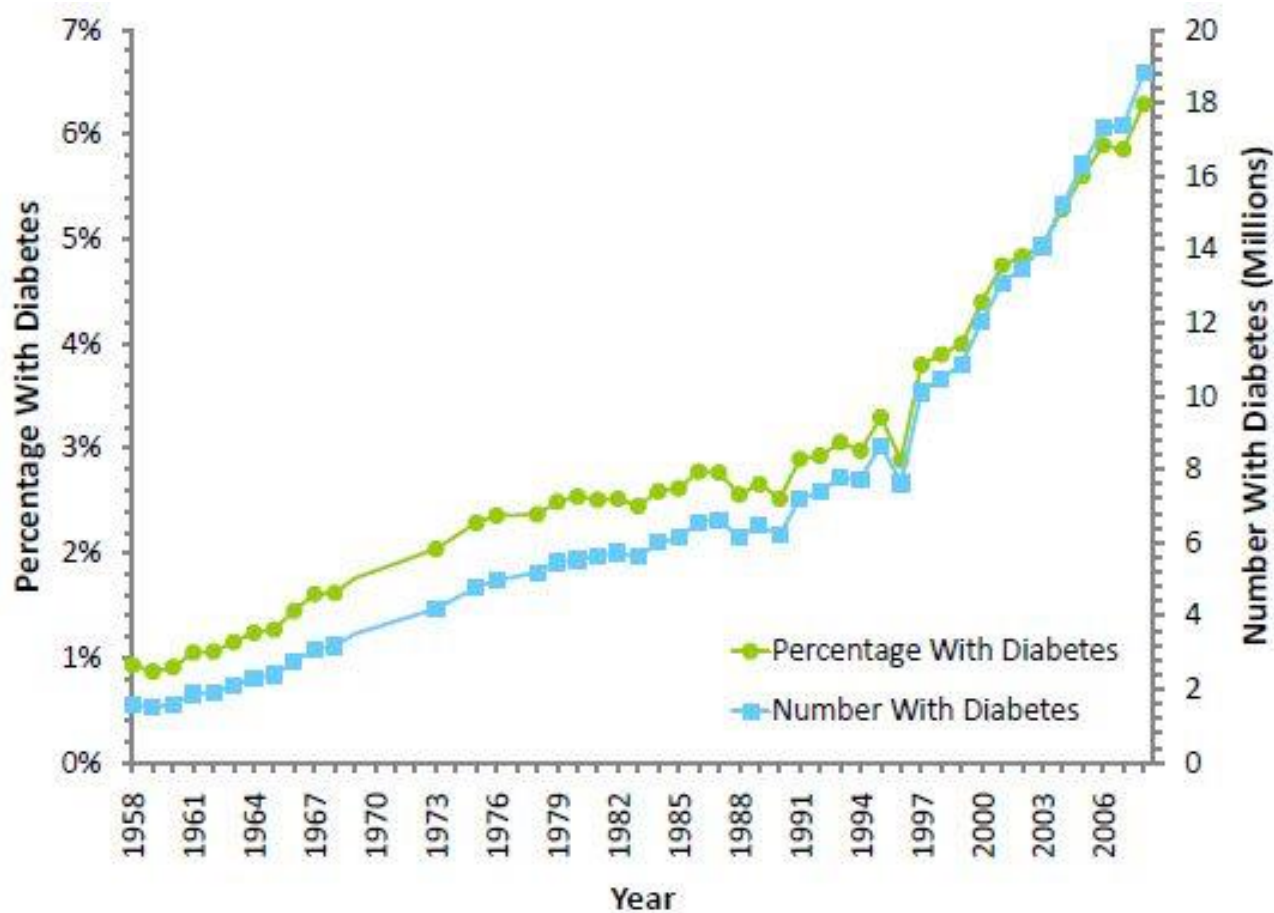
One consequence: humans are very fat!

Human Athleticism



WE EVOLVED TO BE ACTIVE ATHLETES

Human Athleticism



Inactivity is a mismatch with our evolved bodies, leading to health problems

Thank you!

SITN would like to acknowledge the following organizations for their generous support.

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