A History of (Mostly Vertebrate) Locomotion

1,000,000,000 years in 40 minutes
1859

Charles Darwin

*On the Origin of Species*
1859

Charles Darwin

*On the Origin of Species*

“descent with modification”
1859

Charles Darwin

*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 beginning
From one cell, many
From one cell, many
Multiple cells allows for specialized tissues
Muscle: The “Prime Mover”
Muscle: The “Prime PULLER”

K.L. Feilich

575M

800M

10^8

10^9

10^{'

Kara Feilich
Muscles and Little Else
Muscles and Little Else

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Muscles and Little Else

K.L. Feilich
Muscles and Little Else

K.L. Feilich
Bones Matter

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Bones Matter, and Let You Have Joints
Paired Fins: The Body is No Longer the Only Motor
Teleosts: Lighter and Nimbler
Water’s great, but land means WEIGHT

NASA-Bill Stafford/ Public Domain
Water’s great, but land means WEIGHT
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 modification”

i.e. animals are related to each other and descended from common ancestors
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
APES
intelligent
arboreal
quadrupedal

HUMANS
very intelligent
terrestrial
bipedal
APES
Intelligent
arboreal
quadrupedal

HUMANS
very intelligent
terrestrial
bipedal
APES
Intelligent
arboreal
quadrupedal

HUMANS
very intelligent
terrestrial
bipedal
LCA (6-8 m.y.a.)

probably chimp-like
“hominins”

LCA (6-8 m.y.a.)

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?

Buckner and Krienen (2014)
What is the defining characteristic of hominins?

Brain Size?

Buckner and Krienen (2014)

NOPE
What is the defining characteristic of hominins?

Terrestrialism?
What is the defining characteristic of hominins?

Terrestrialism?
What is the defining characteristic of hominins?

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?

**Yes!**

- *Sahelanthropus* (7 m.y.a.)
- *Orrorin* (6 m.y.a.)
- *Ardipithecus* (4.4 m.y.a.)
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?

Tall 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

Movement Cost (energy)

Body Mass (kg)

Sockol et al. (2007)

Energetic Hypothesis
So why are hominins bipedal?

Energetic Hypothesis

Pretty well supported

Movement Cost (energy) vs Body Mass (kg)

Sockol et al. (2007)
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

Women: ~25% body fat

Men: ~15% body fat

One consequence: humans are very fat!
WE EVOLVED TO BE ACTIVE ATHLETES
Human Athleticism

Inactivity is a mismatch with our evolved bodies, leading to health problems.
Thank you!

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