

Genetics of Athletic Ability:

Is athletic performance encoded in your DNA?



Heather Landry
DayCon 2016

What contributes to athletic ability?

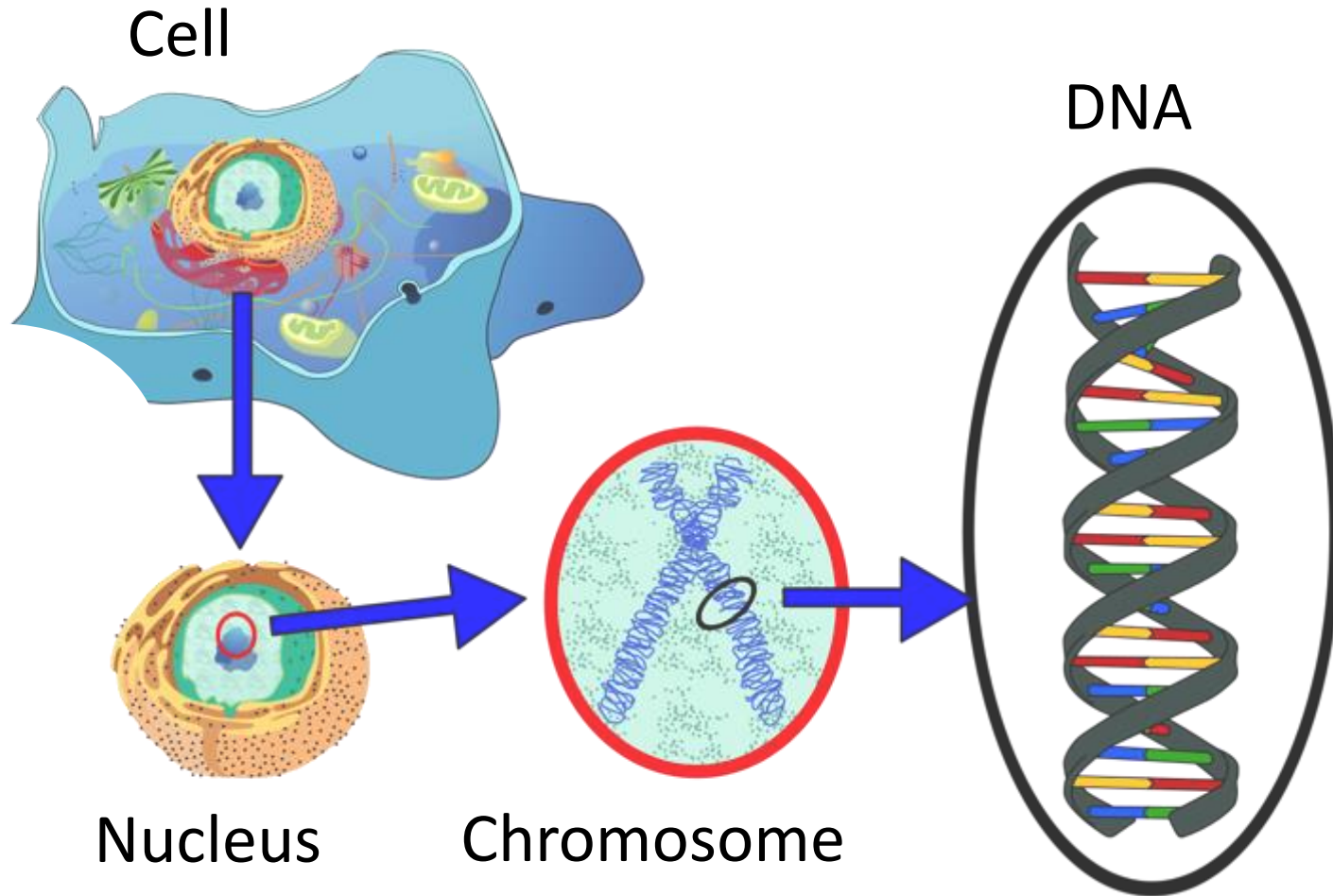


Yao Ming: Keith Allison via Wikimedia Commons
Gymnast: Pierre-Yves Beaudouin via Wikimedia Commons
Atsede Baysa: Benjamin Lipsman

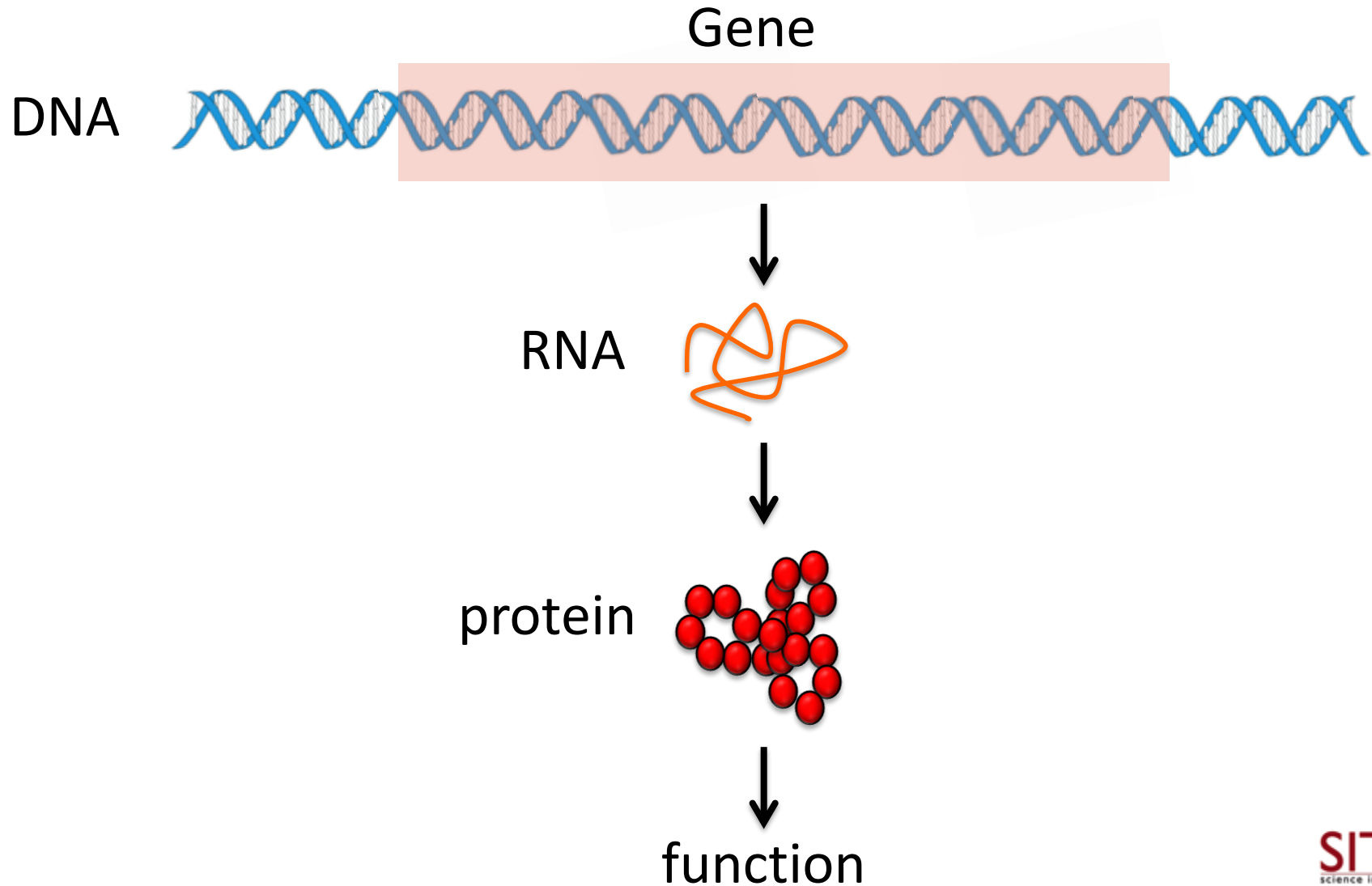
Roadmap

1. What is genetics?
2. Is athletic ability inherited?
3. Which genes influence to athletic ability?

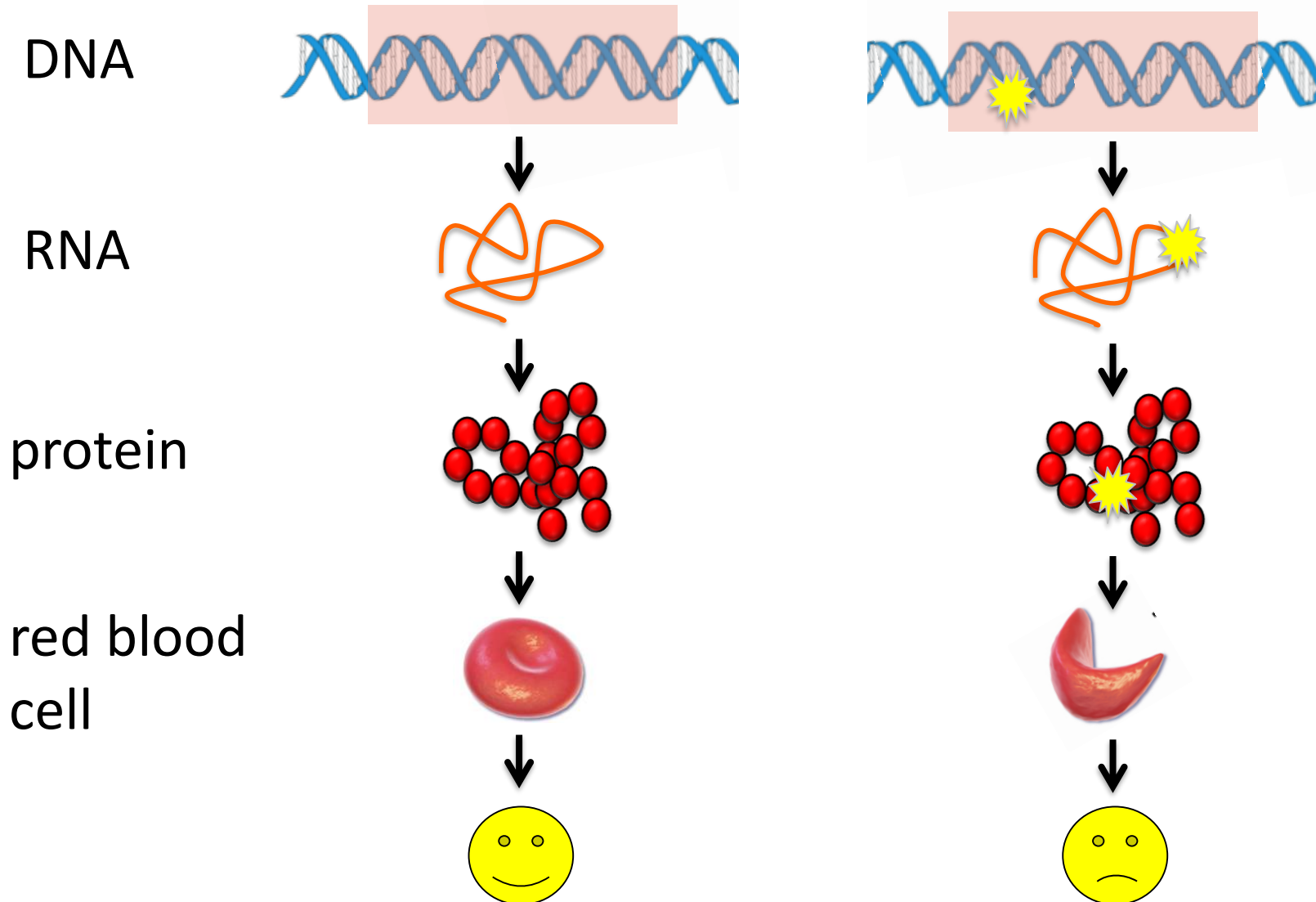
Every cell has the same DNA sequence



DNA guides protein production

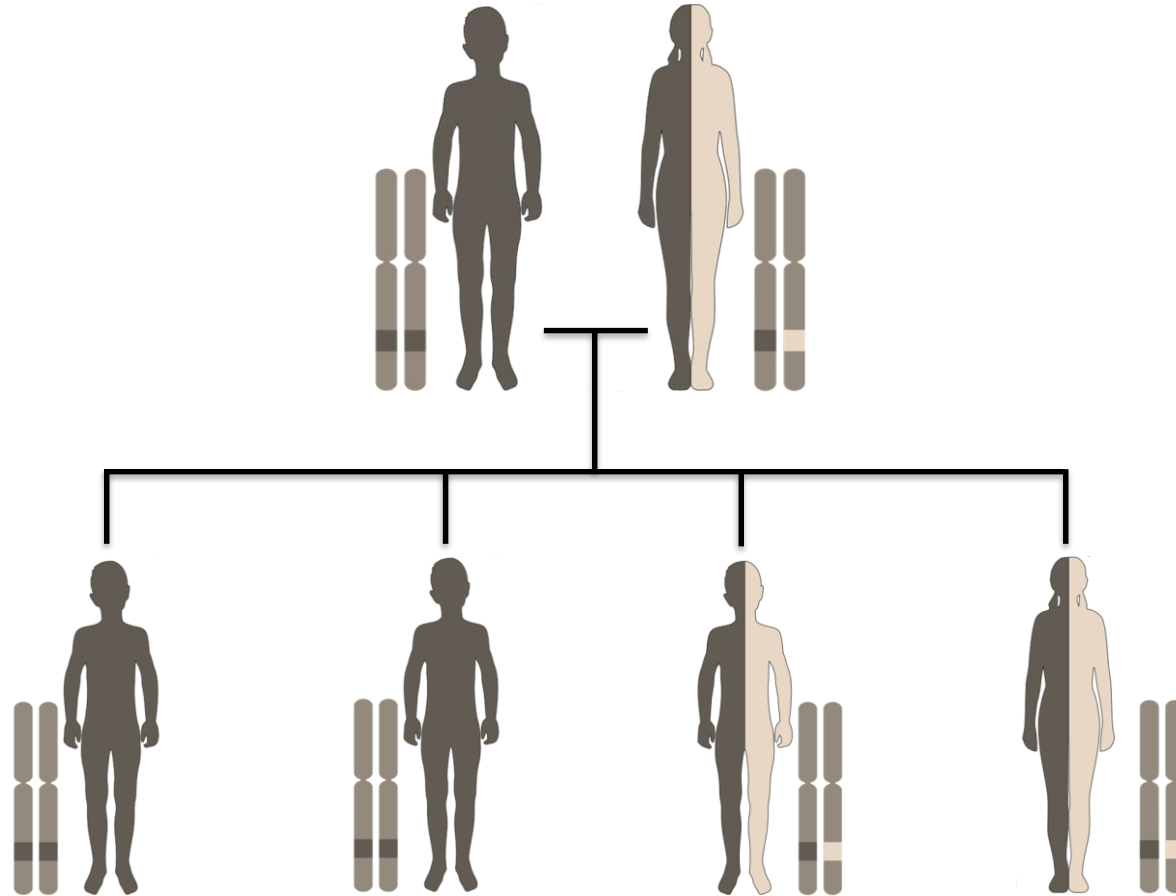


DNA changes influence protein function



Questions?

DNA gets inherited from parents to children

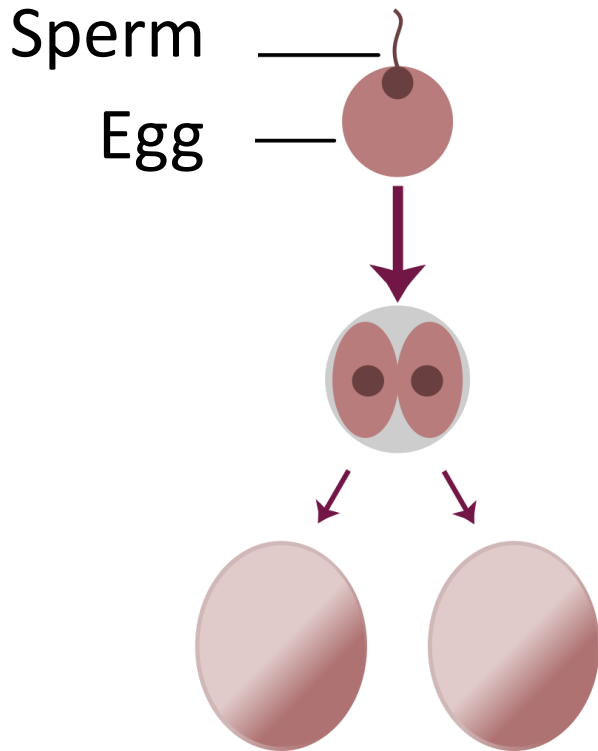


Twins can be used to understand whether athletic ability is inherited

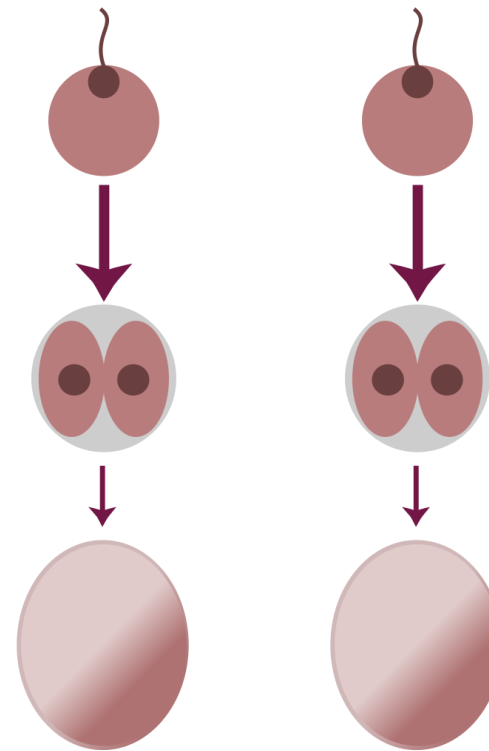


Identical twins have identical DNA

Identical twins

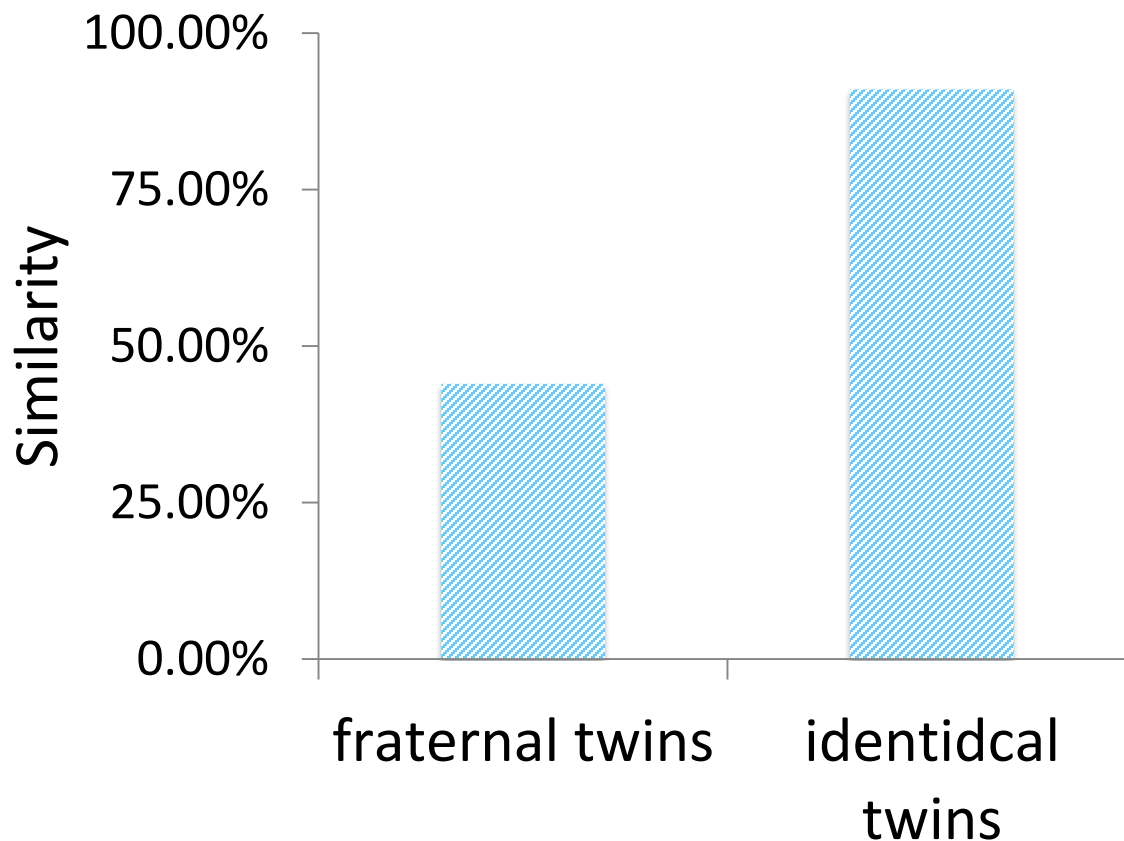


Fraternal twins



Identical twins have similar athletic traits

Maximal Oxygen Uptake

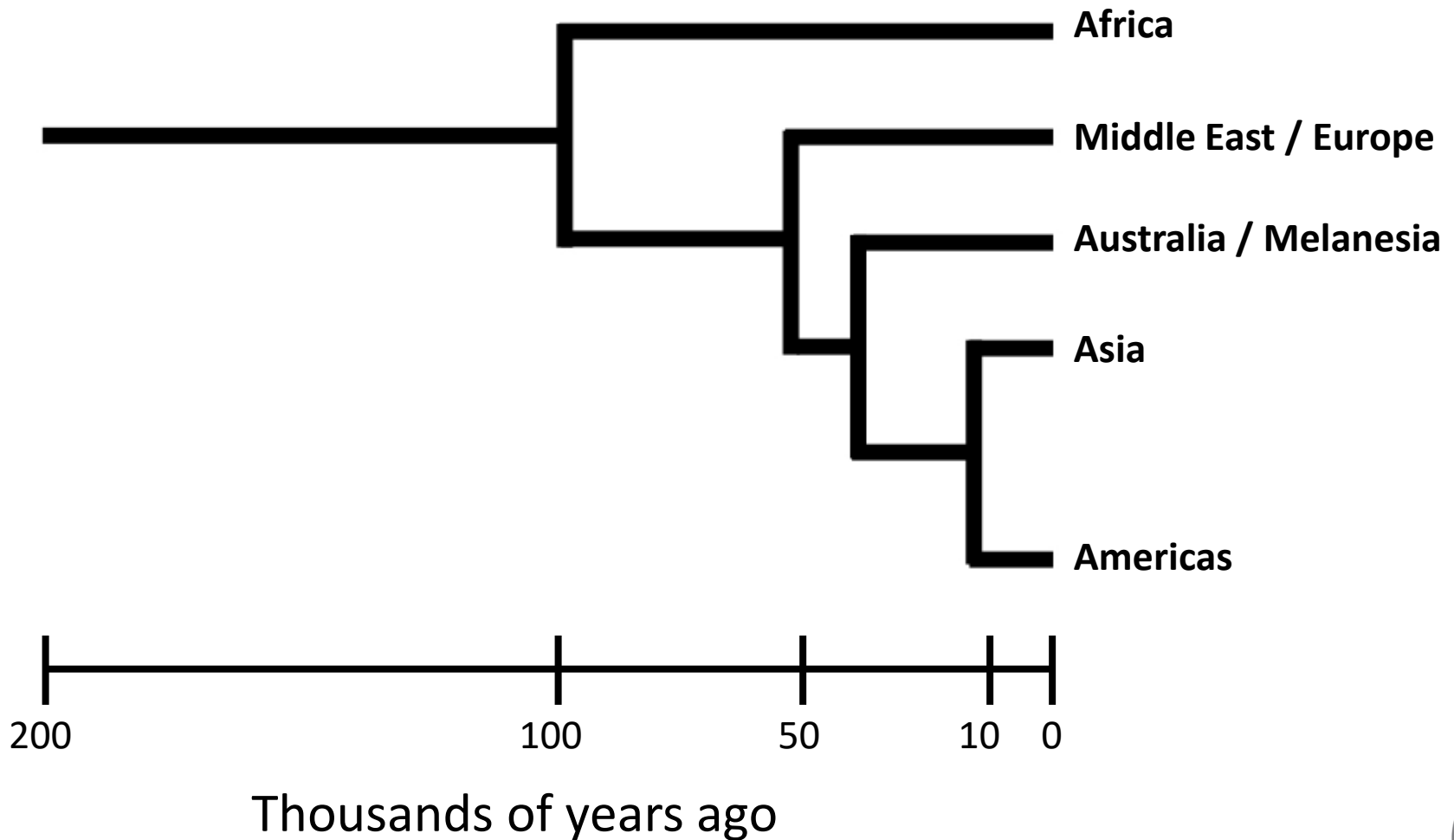


Questions?

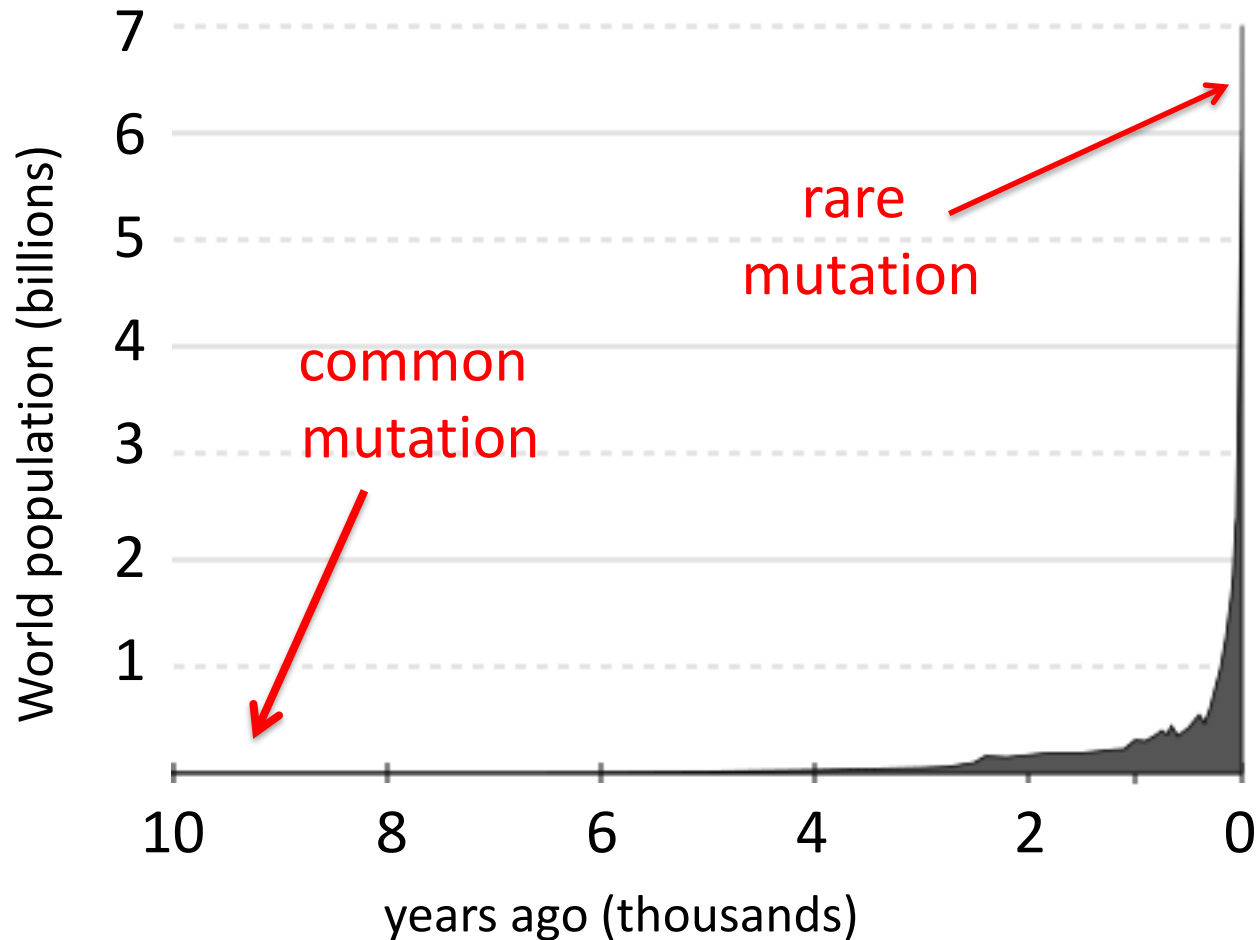
It is challenging to find the genes responsible for athletic ability



Humans have been around for a long time



Human population growth is very recent



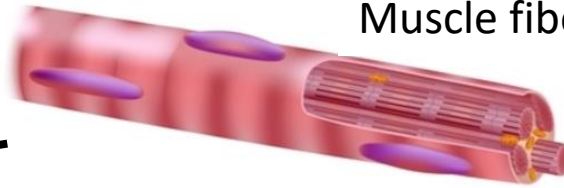
alpha-actinin 3 (*ACTN3*)

Interacts with actin to help coordinate muscle contractions in fast twitch muscle fibers.

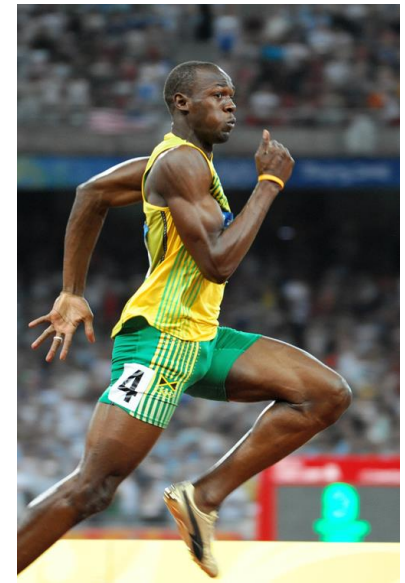
slow twitch



Muscle fiber

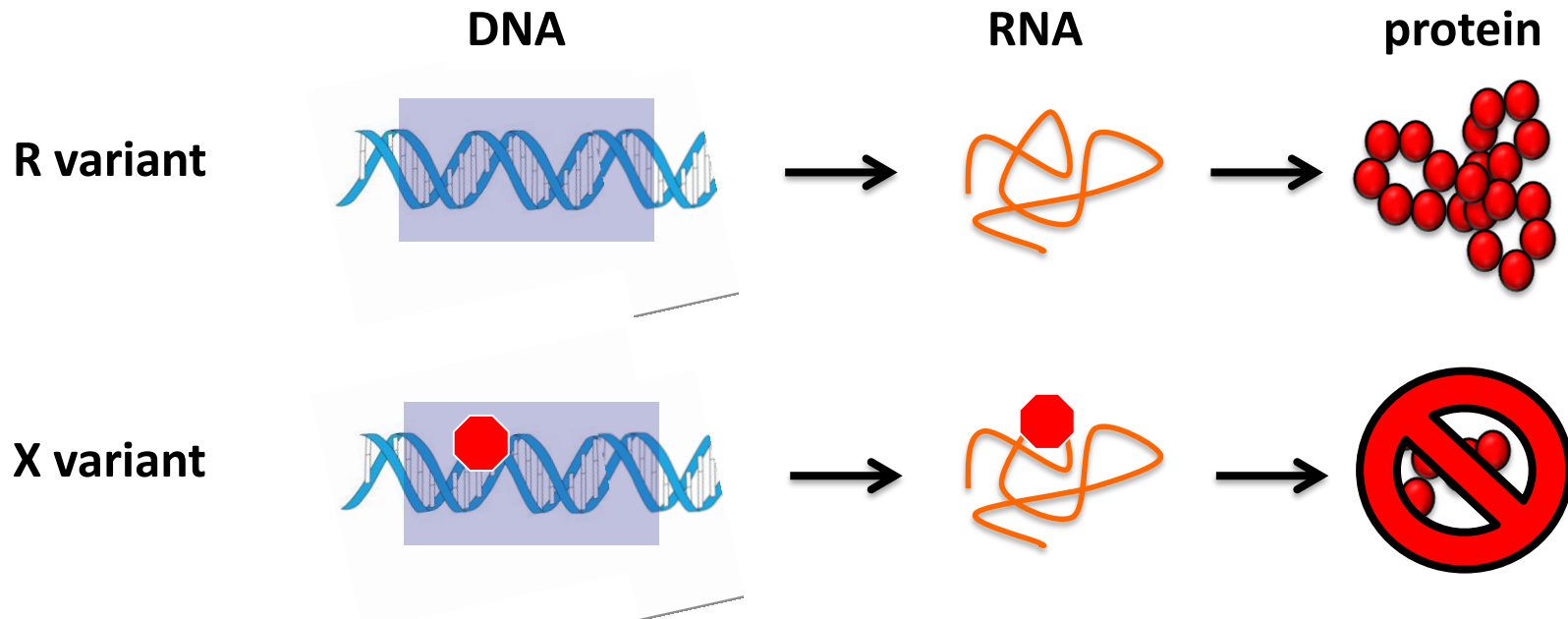


fast twitch

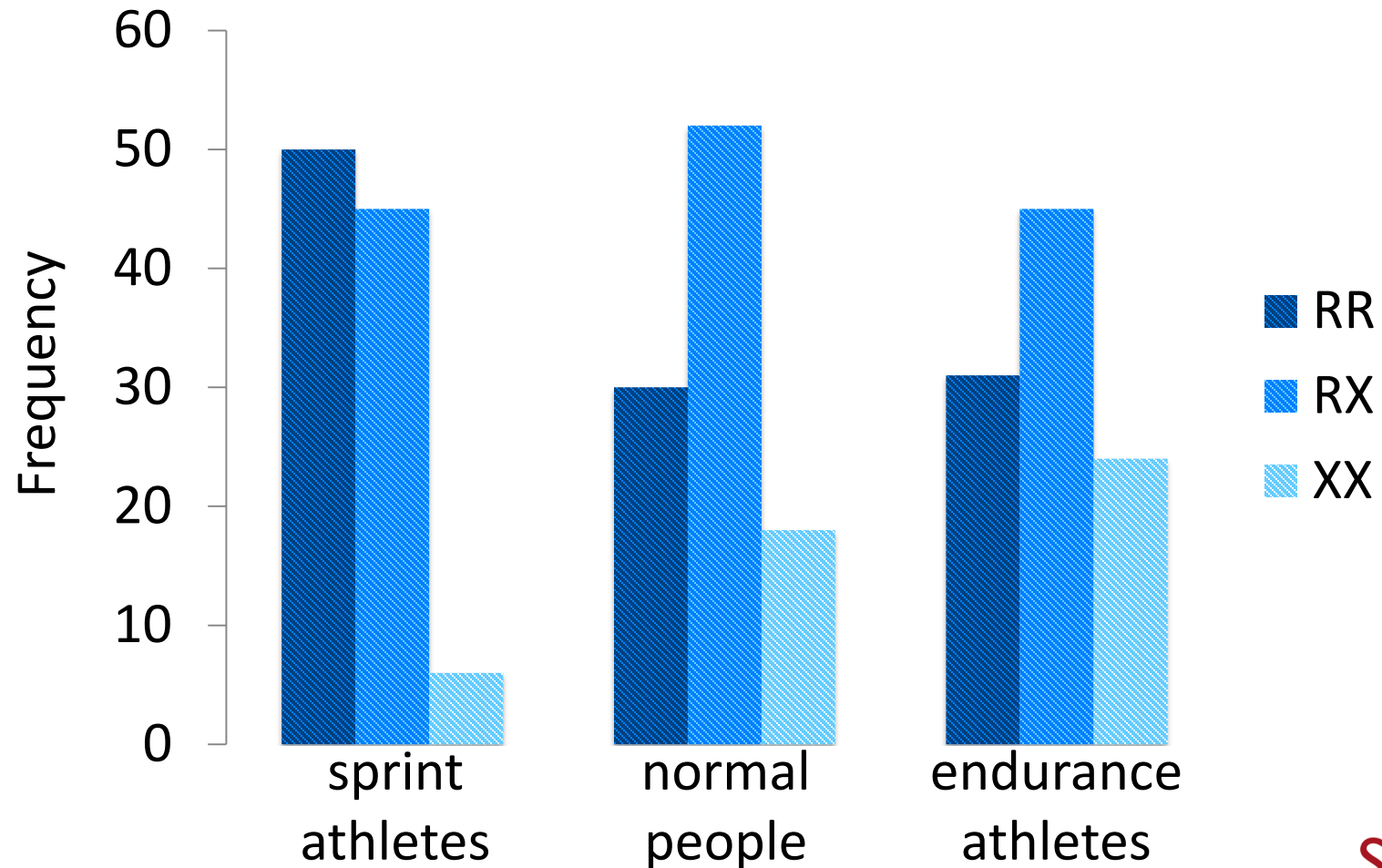


A common mutation in *ACTN3*

- There is a mutation in the *ACTN3* gene that is very common in the human population.
- This mutation causes complete loss of protein function.



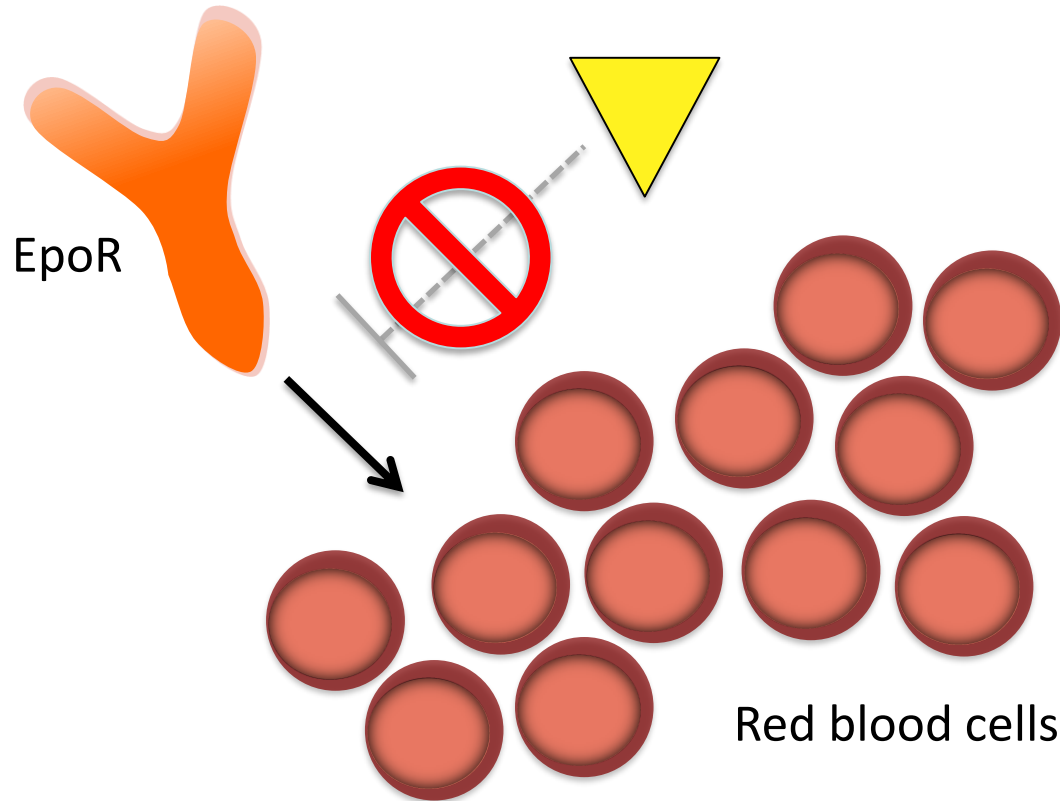
ACTN3 is more commonly mutated in endurance athletes versus sprinters



erythropoietin receptor (*EPO*R)

Signals the production of red blood cells

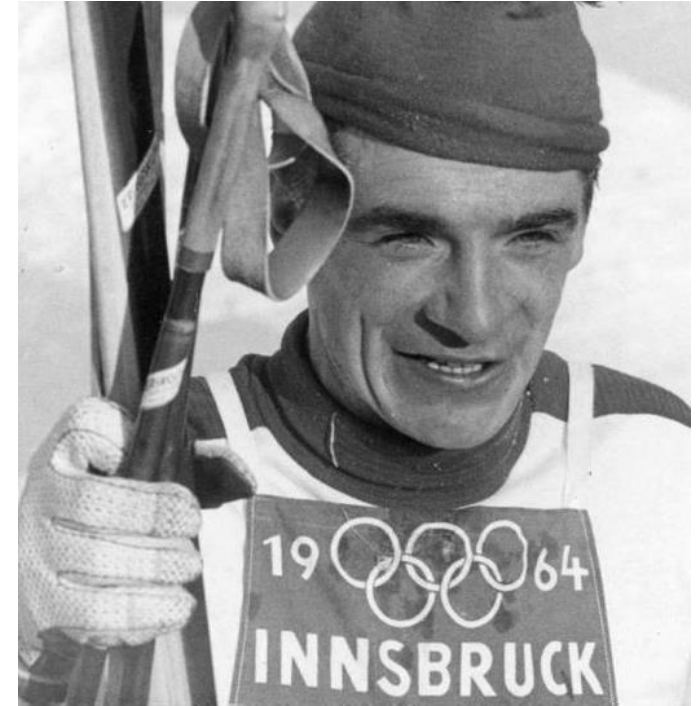
EPO



Red blood cells

Eero Mäntyranta

- Finish cross-country skier who had a mutation in the *EPOR* gene that increased his red blood cell numbers.
- More red blood cells increases hemoglobin levels, oxygen intake, and endurance.
- Eero won 7 medals in 4 Winter Olympics.



Conclusions

- Athletic ability can be an inherited trait.
- Both common variants (e.g. mutation in *ACTN3*) and rare variants (e.g. mutation in *EPOR*) can influence athletic ability.
- Many genes often work in combination and other elements (e.g. nutrition or environment) can contribute to athletic ability.

Thank you!

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

Harvard Medical School

Office of Communications and External Relations
Division of Medical Sciences

The Harvard Graduate School of Arts and Sciences (GSAS)

The Harvard Graduate Student Council (GSC)

The Harvard Biomedical Graduate Students Organization (BGSO)

The Harvard/MIT COOP