



FRA  
BIG BANG  
TIL  
MODERNE MENNESKE



# Skabelsesberetninger...





# Tidlig forestilling om vores verden



U r b i et o r b i

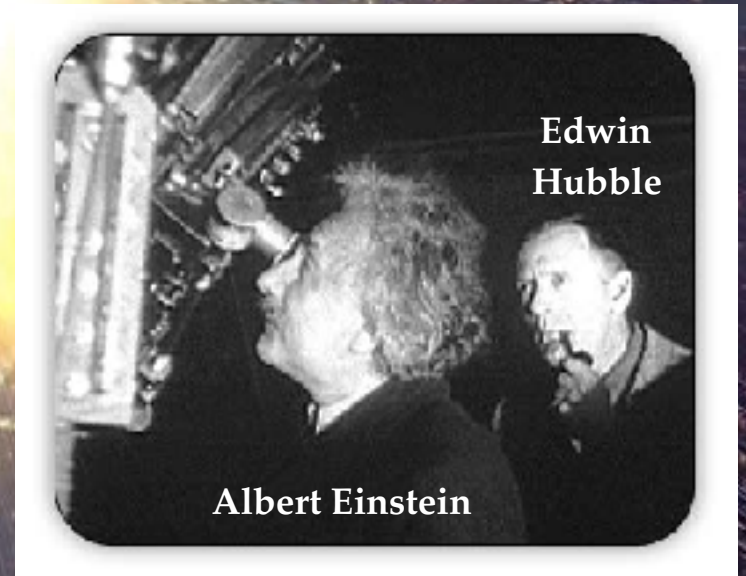


13.8 milliarder år siden...

**Big Bang**



# Hubbles opdagelse (1929)



Edwin  
Hubble

Albert Einstein



# Hubbles opdagelse (1929)

Velocity-Distance Relation among Extra-Galactic Nebulae.

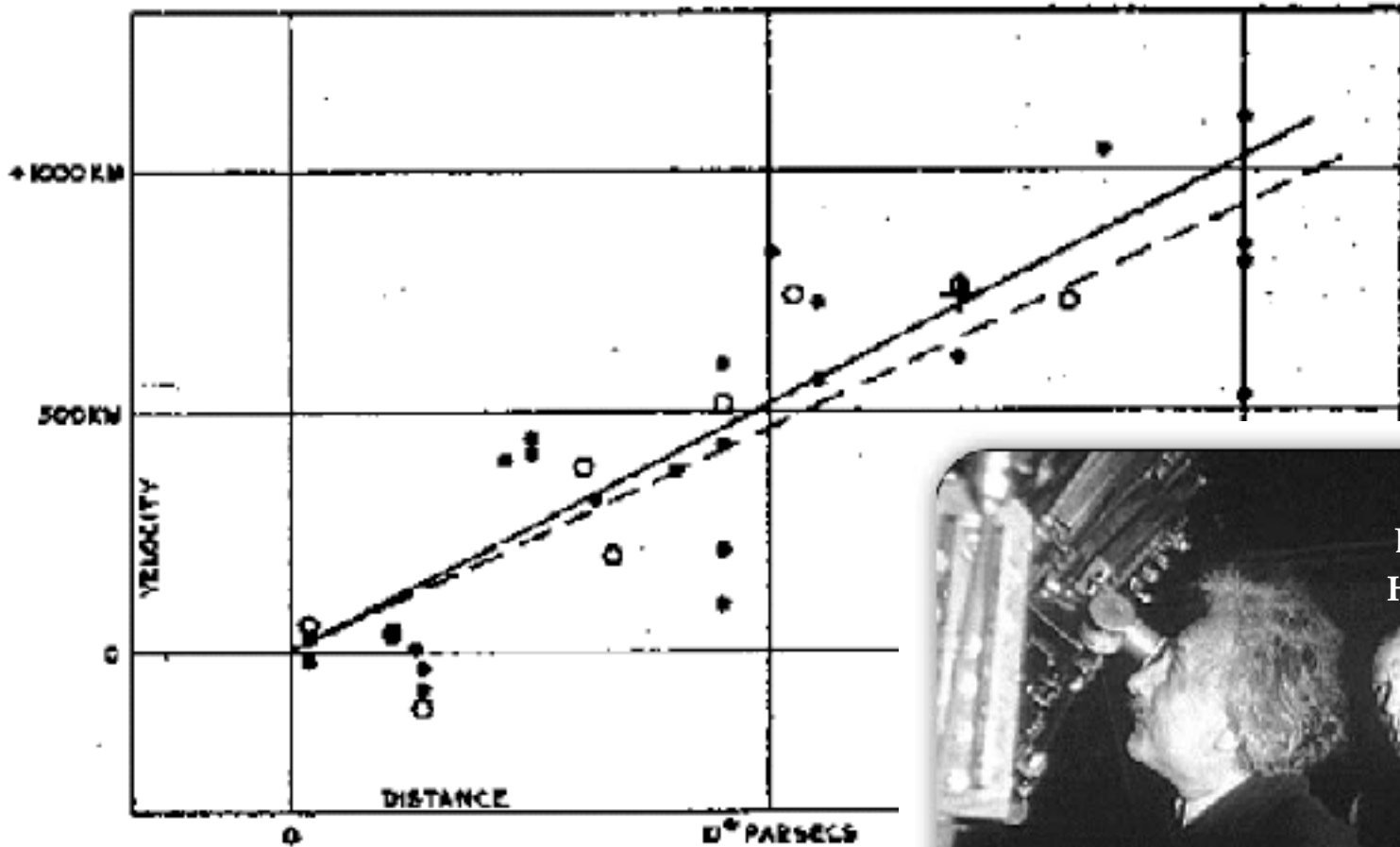
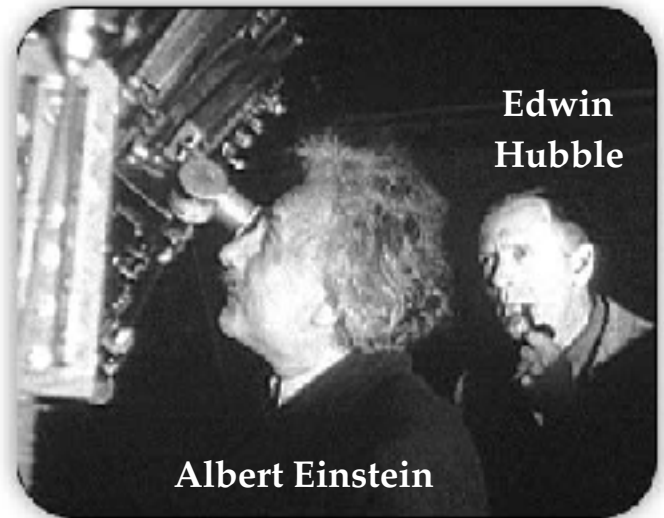


FIGURE 1



Edwin Hubble

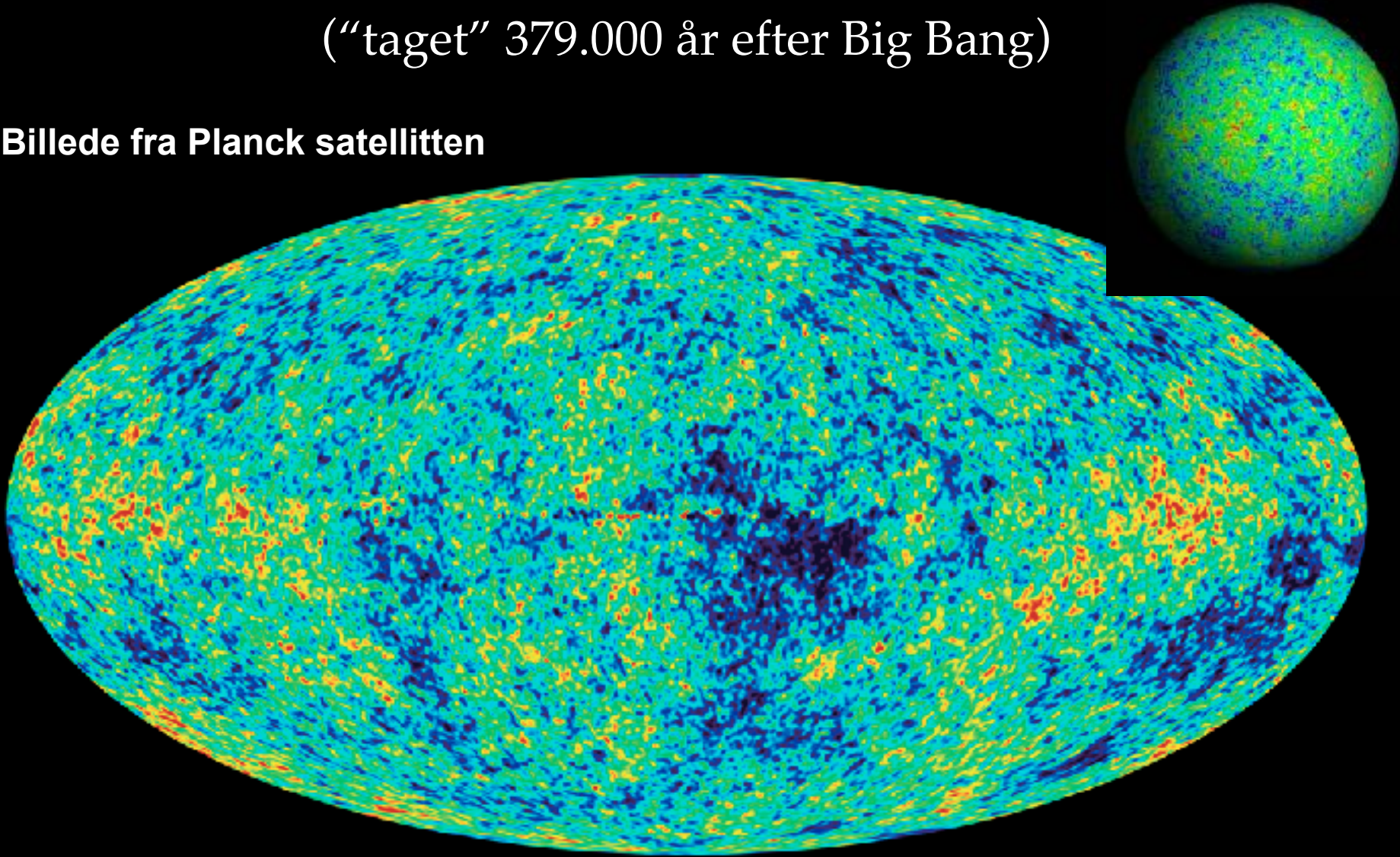
Albert Einstein



# Første billede af Universet

(“taget” 379.000 år efter Big Bang)

Billede fra Planck satellitten

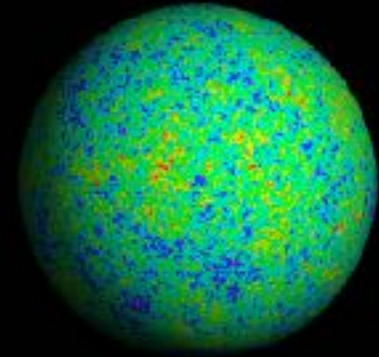




# Første billede af Universet

(“taget” 379.000 år efter Big Bang)

Billede fra Planck satellitten



1% af støj på et TV er  
ekkoet fra Big Bang.





# Universets historie

Første atomer  
379.000 år

Udviklingen af galakser, planeter, etc.

**Big Bang**

Første stjerner ca.  
200 millioner år

Fra Big Bang til i dag

13.8 milliarder år

Hubble-  
teleskopet





# Stjerner og galakser dannes

200 millioner år efter Big Bang





# Stjerner og galakser dannes

200 millioner år efter Big Bang

Antal galakser i universet:

~ 300.000.000.000

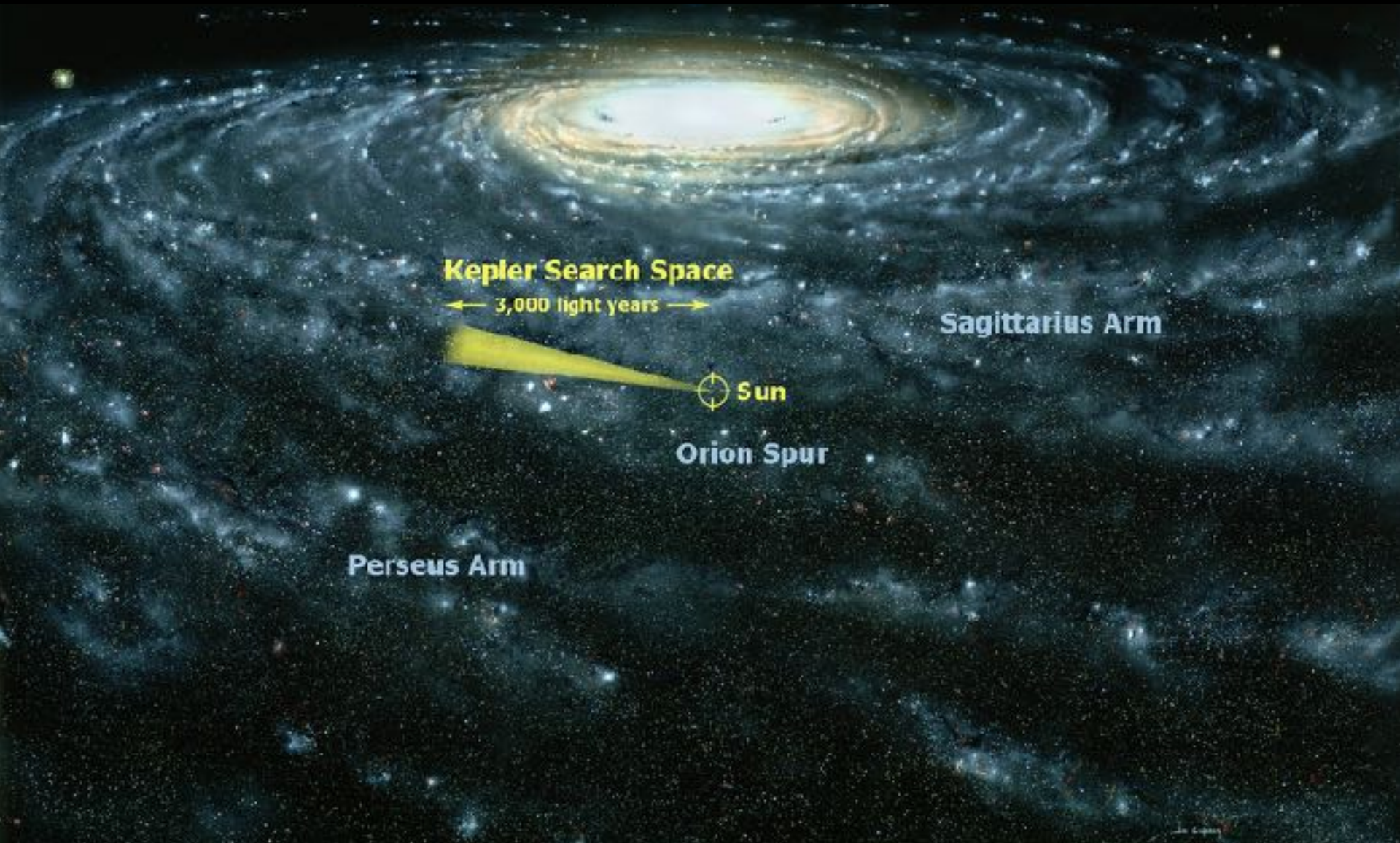
Antal stjerner i en typisk galakse:

~ 300.000.000.000

Antal planeter om en typisk stjerne?

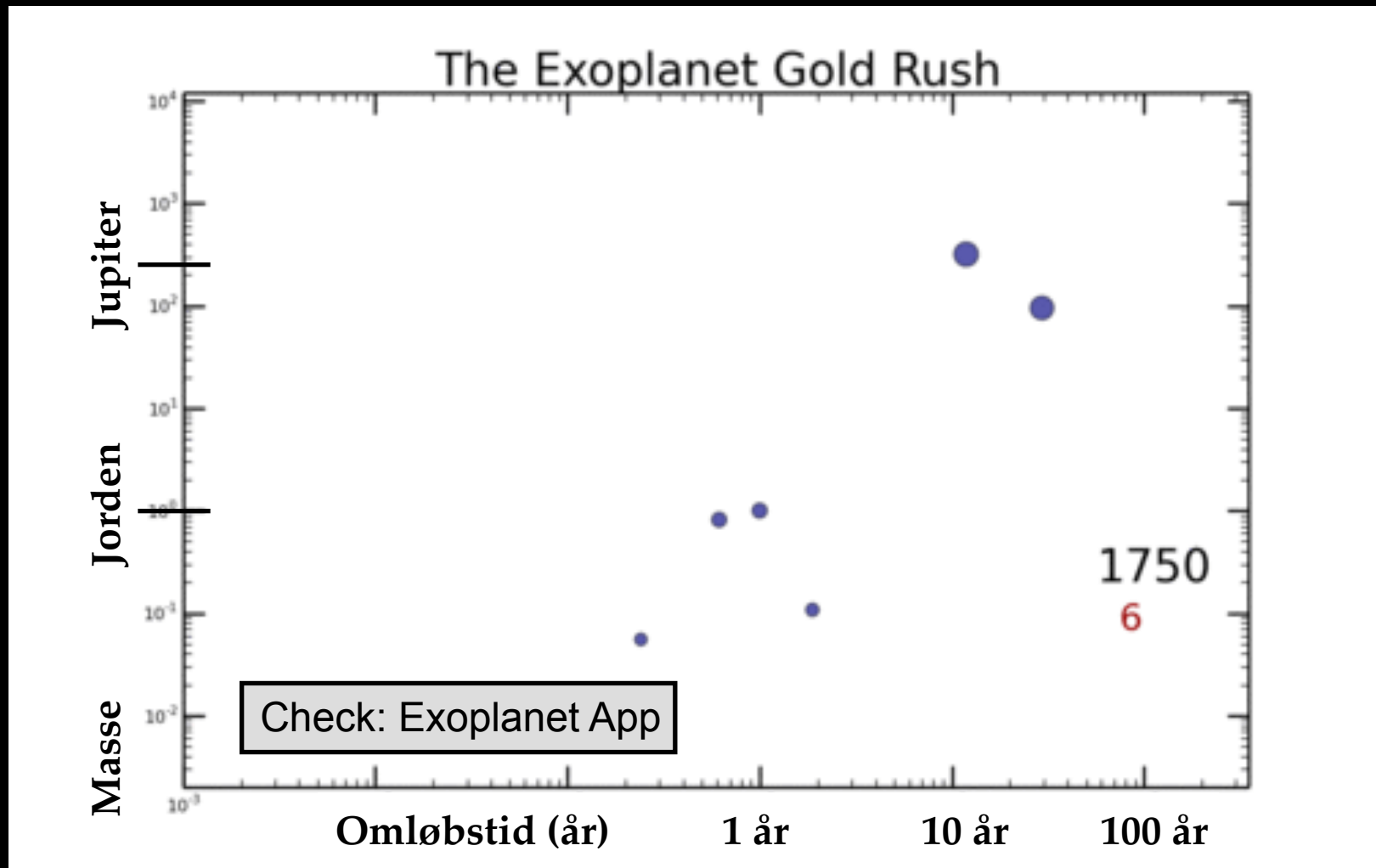


# Planeter i Mælkevejen





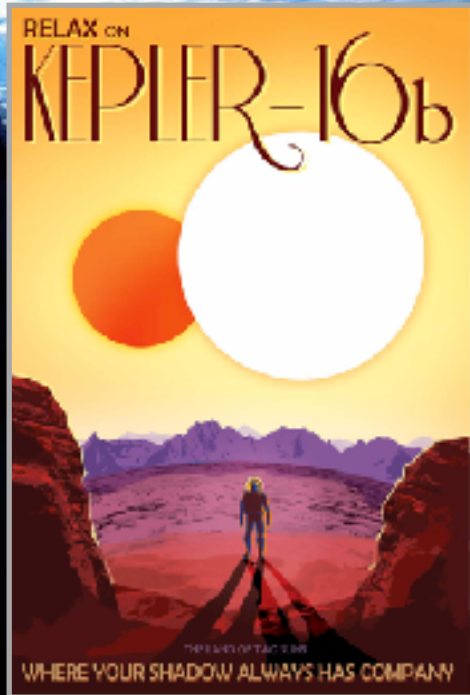
# Opdagelsen af planeter



På Jorden kan man se **seks planeter** med det blotte øje...



# Potentielt beboelige planeter?





# Den beboelige zone





# Den beboelige zone

Indre solsystem

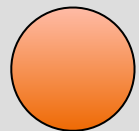
Mercury

Venus

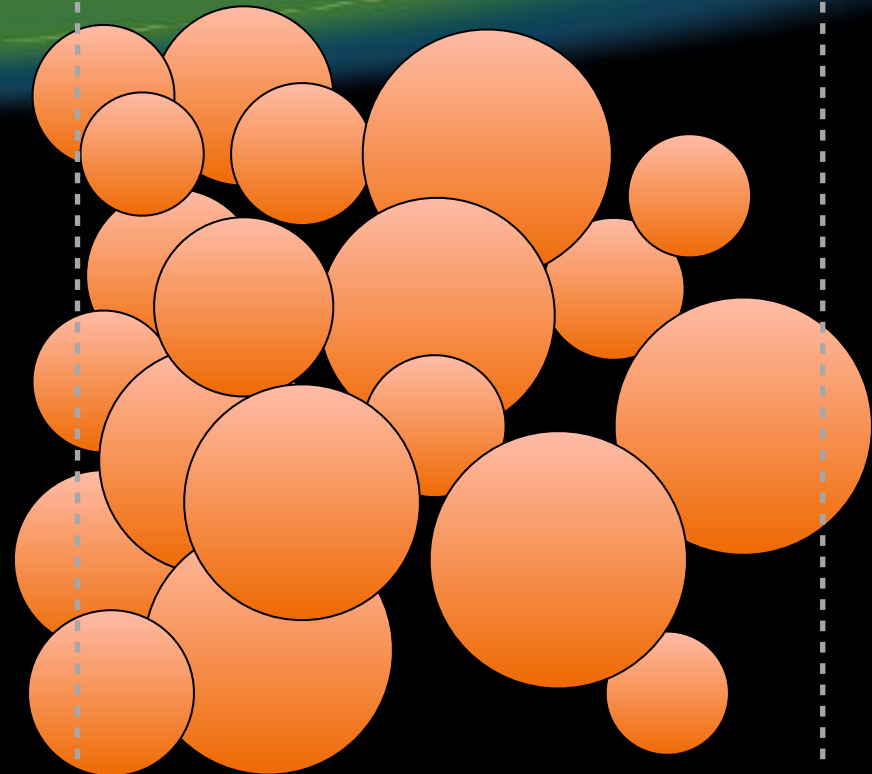
Earth

Mars

Beboelige zone



Verificerede exoplaneter fundet i beboelige zoner





# Stjerner og galakser dannes

200 millioner år efter Big Bang

Antal galakser i universet:

~ 300.000.000.000

Antal stjerner i en typisk galakse:

~ 300.000.000.000

Antal planeter om en typisk stjerne?

~ 1-10

Med mulighed for liv: 0.1-1

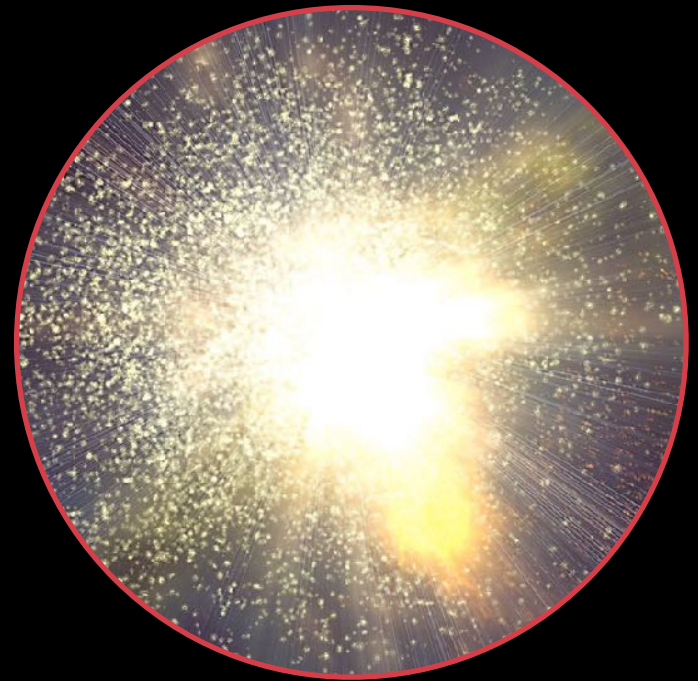


# Grundstoffernes oprindelse

1  
H

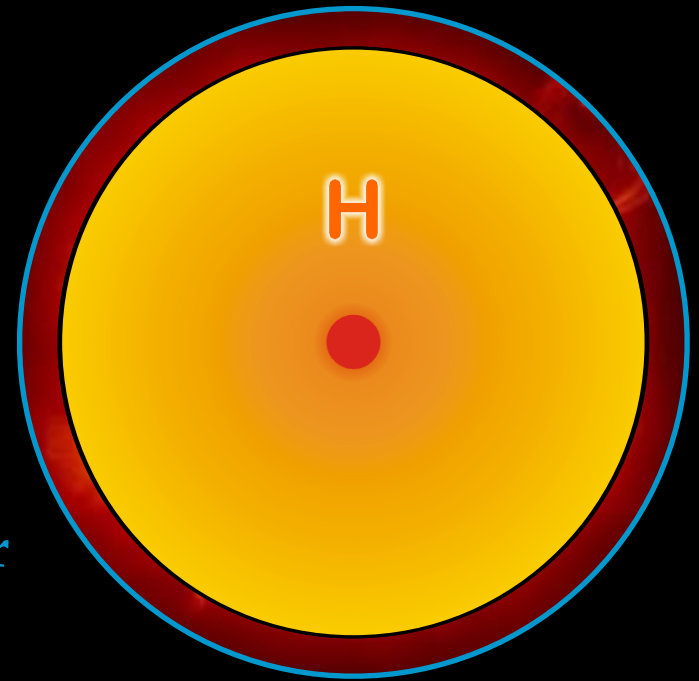
2  
He

Big Bang





# Grundstoffernes oprindelse



Big Bang

Tunge stjerner

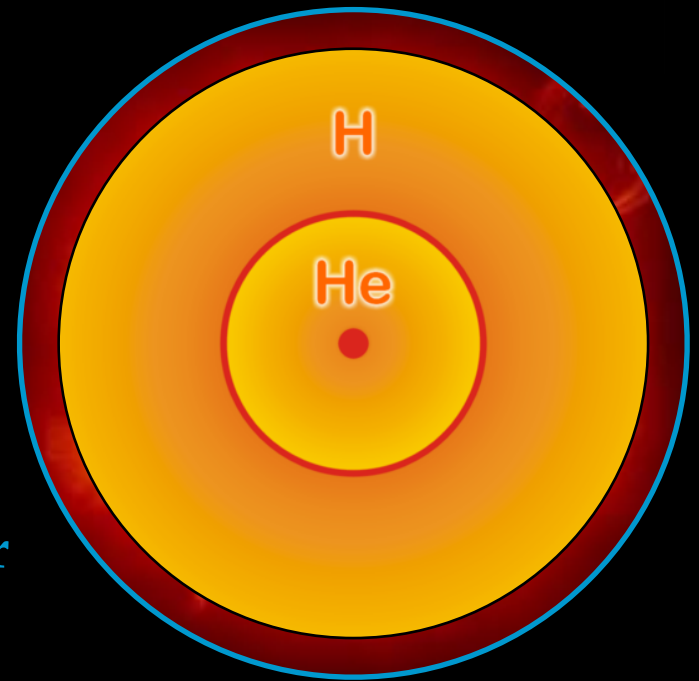


# Grundstoffernes oprindelse



Big Bang

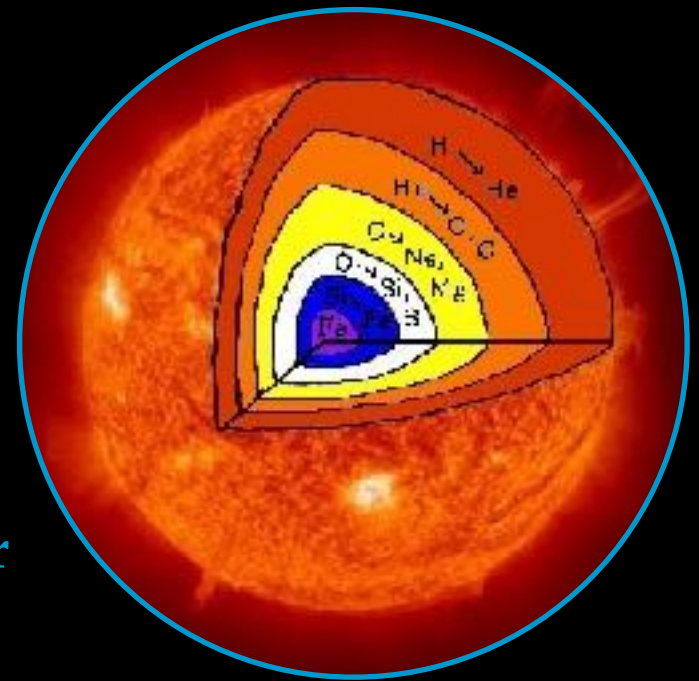
Tunge stjerner



# Grundstoffernes oprindelse

1  
H

2  
He



Big Bang

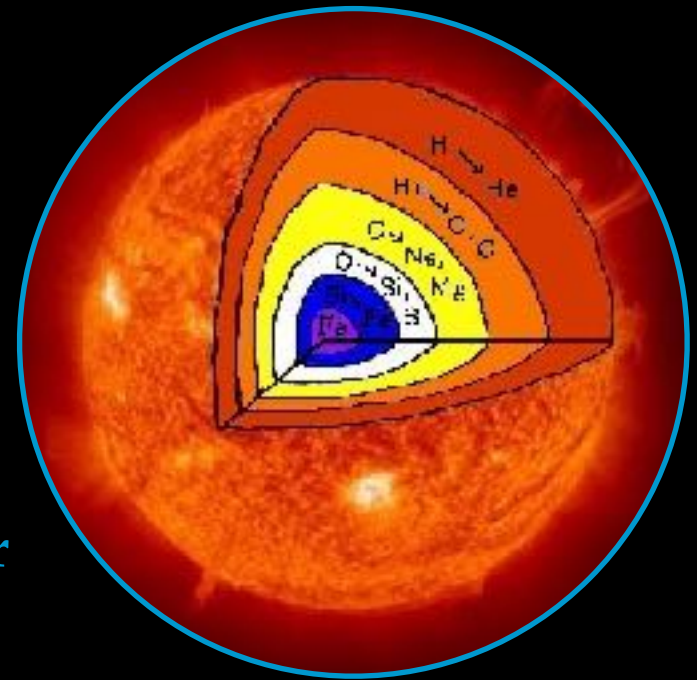
Tunge stjerner



# Grundstoffernes oprindelse

1 H							
3 Li							
11 Na	12 Mg						
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe

				2 He	
	6 C	7 N	8 O	9 F	10 Ne
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar



Big Bang

Tunge stjerner

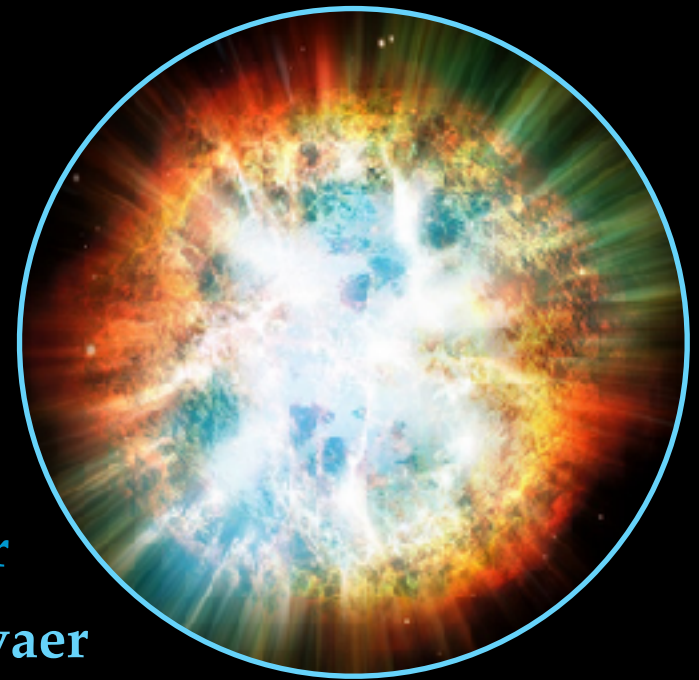
# Grundstoffernes oprindelse





# Grundstoffernes oprindelse

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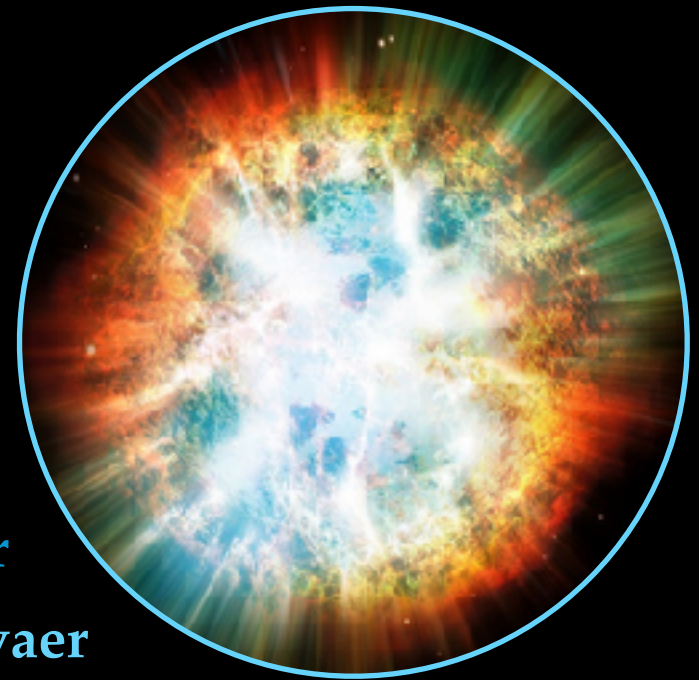


Big Bang

Tunge stjerner  
Type 1a supernovaer

# Grundstoffernes oprindelse

1 H																	2 He
3 Li												6 C	7 N	8 O	9 F	10 Ne	
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19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb																	



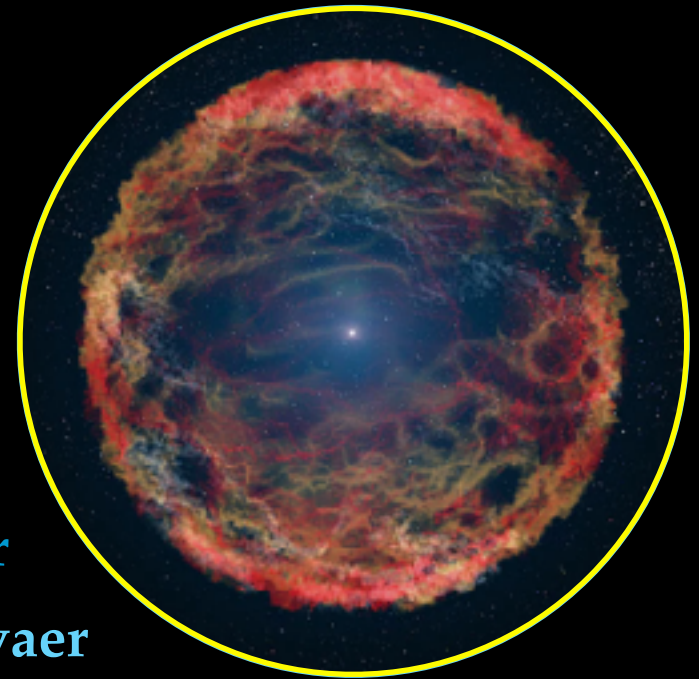
Big Bang

Tunge stjerner  
Type 1a supernovaer



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Big Bang

Tunge stjerner

Type 1a supernovaer

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37 Rb																	



Big Bang

Tunge stjerner

Type 1a supernovaer

Neutron stjerner



# Grundstoffernes oprindelse



Type 1a supernovaer

Neutron stjerner

# Grundstoffernes oprindelse

1 H																		2 He	
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37 Rb																			



**Big Bang**

**Tunge stjerner**

**Type 1a supernovaer**

**Neutron stjerner**



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1 H																	2 He									
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37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe									
55 Cs	56 Ba											72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra																									
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb																
		89 Ac	90 Th	91 Pa	92 U																					



Big Bang

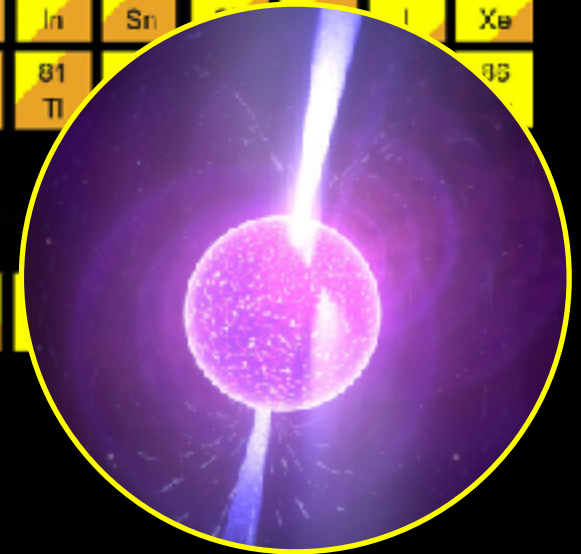
Tunge stjerner

Type 1a supernovaer

Neutron stjerner

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1 H																	2 He									
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Big Bang

Tunge stjerner

Type 1a supernovaer

Neutron stjerner



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1 H																	2 He	
3 Li												6 C	7 N	8 O	9 F	10 Ne		
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				57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
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Big Bang

Tunge stjerner

Type 1a supernovaer

Neutron stjerner

# Grundstoffernes oprindelse

1 H																	2 He	
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
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				89 Ac	90 Th	91 Pa	92 U											

Big Bang

Tunge stjerner

Rød kæmpe fase

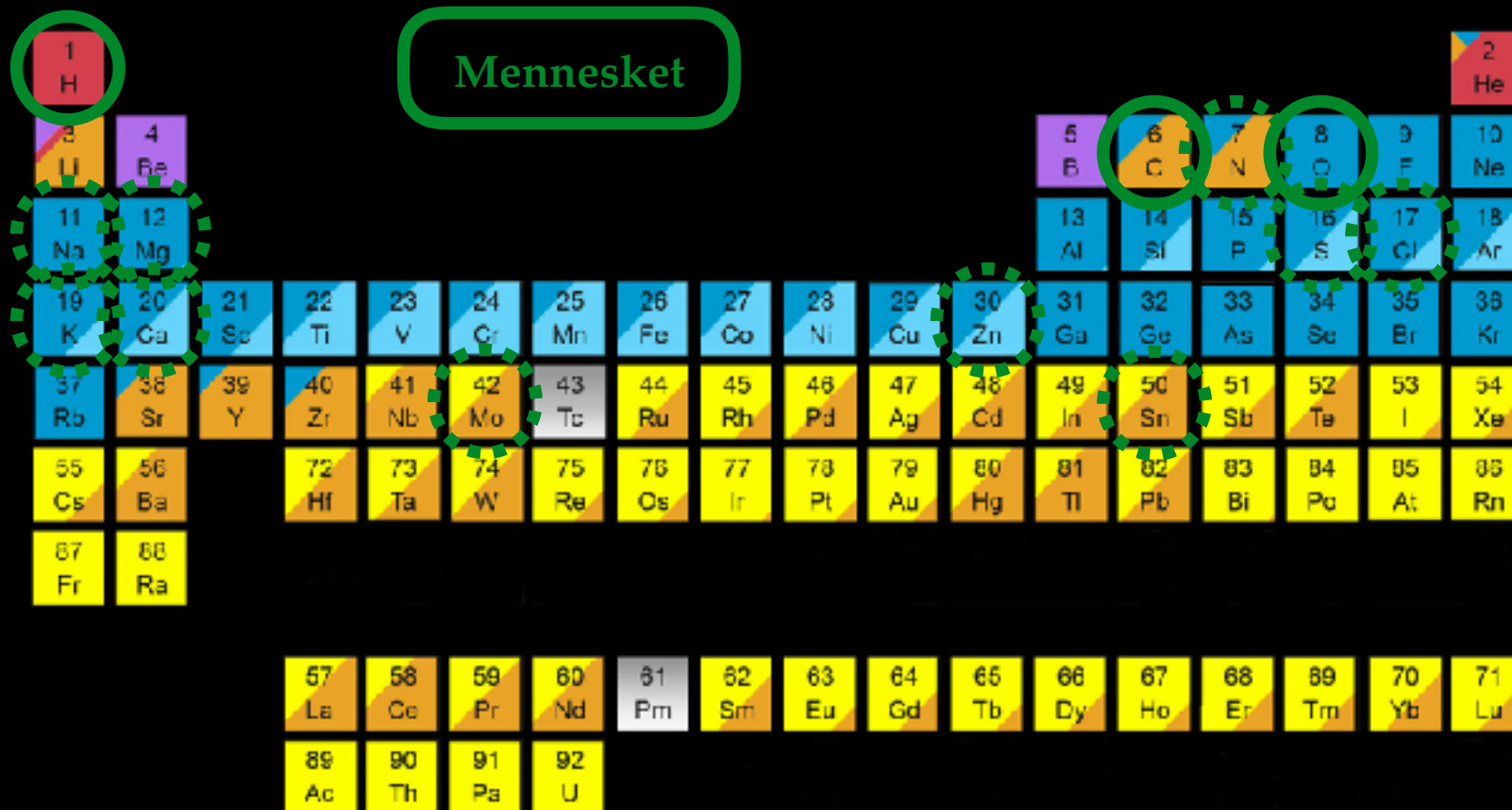
Kosmiske stråler

Type 1a supernovaer

Neutron stjerner



# Grundstoffernes oprindelse



# Grundstoffer

lige efter Big Bang





# Grundstoffer

i dag



▪  
Mg

▪  
C

▪  
N

▪  
O

▪  
Ne

▪  
Si

▪  
S

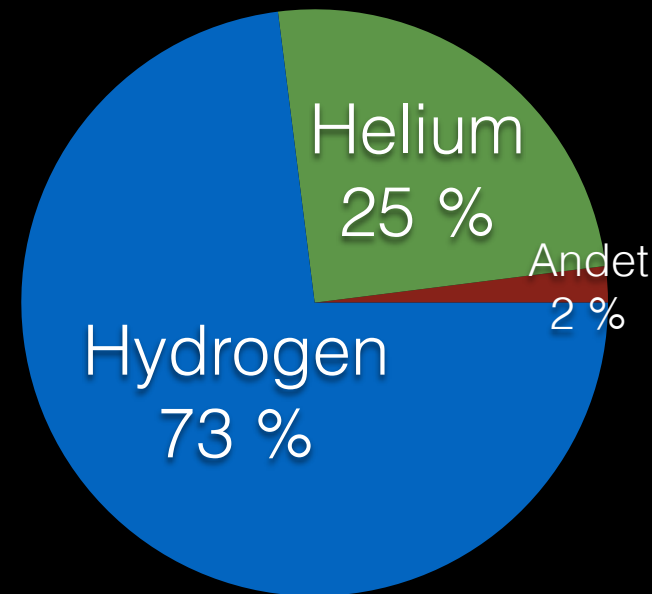
▪  
Ar

▪  
Fe

# Grundstoffernes hyppighed

De letteste grundstoffer findes der flere af i **Universet**, men **Jorden** og **mennesker** er lavet af tungere grundstoffer.

## Universet

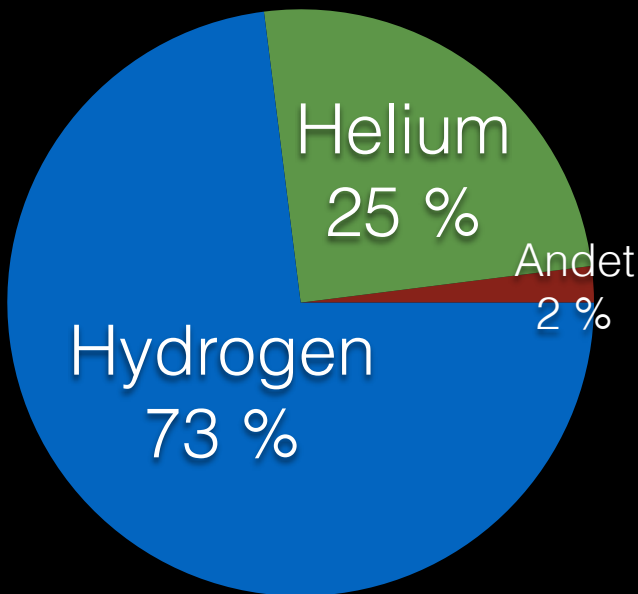


Forskellene kan forklares med af **mekanismerne** bag

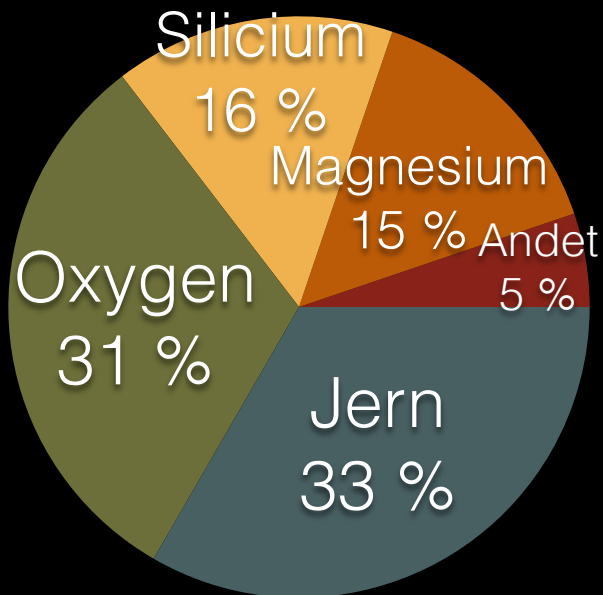
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## Universet



## Jorden



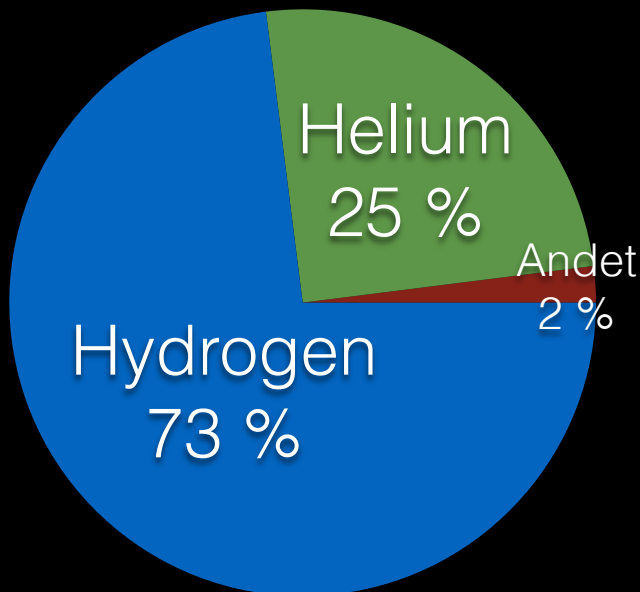
Forskellene kan forklares med af **mekanismerne** bag



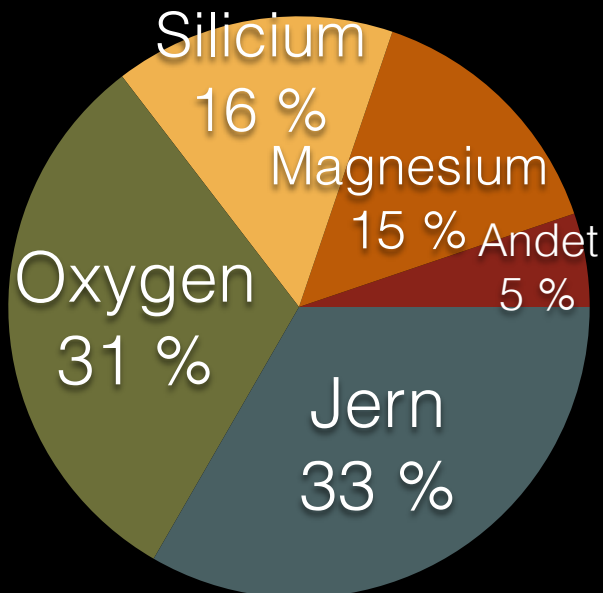
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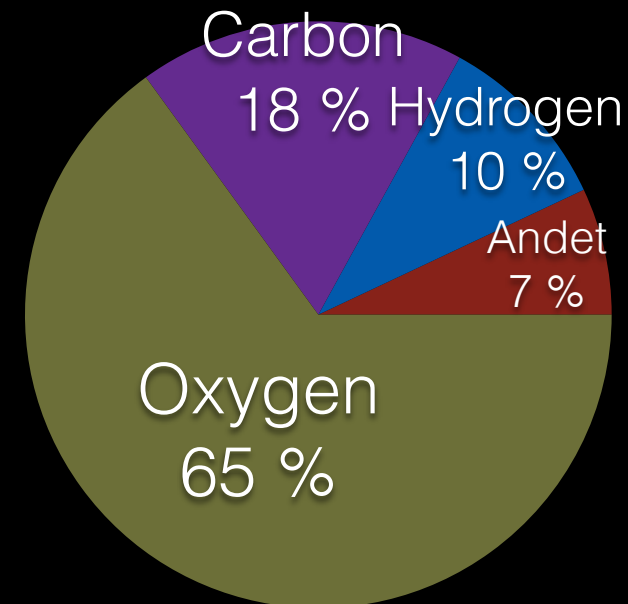
## Universet



## Jorden



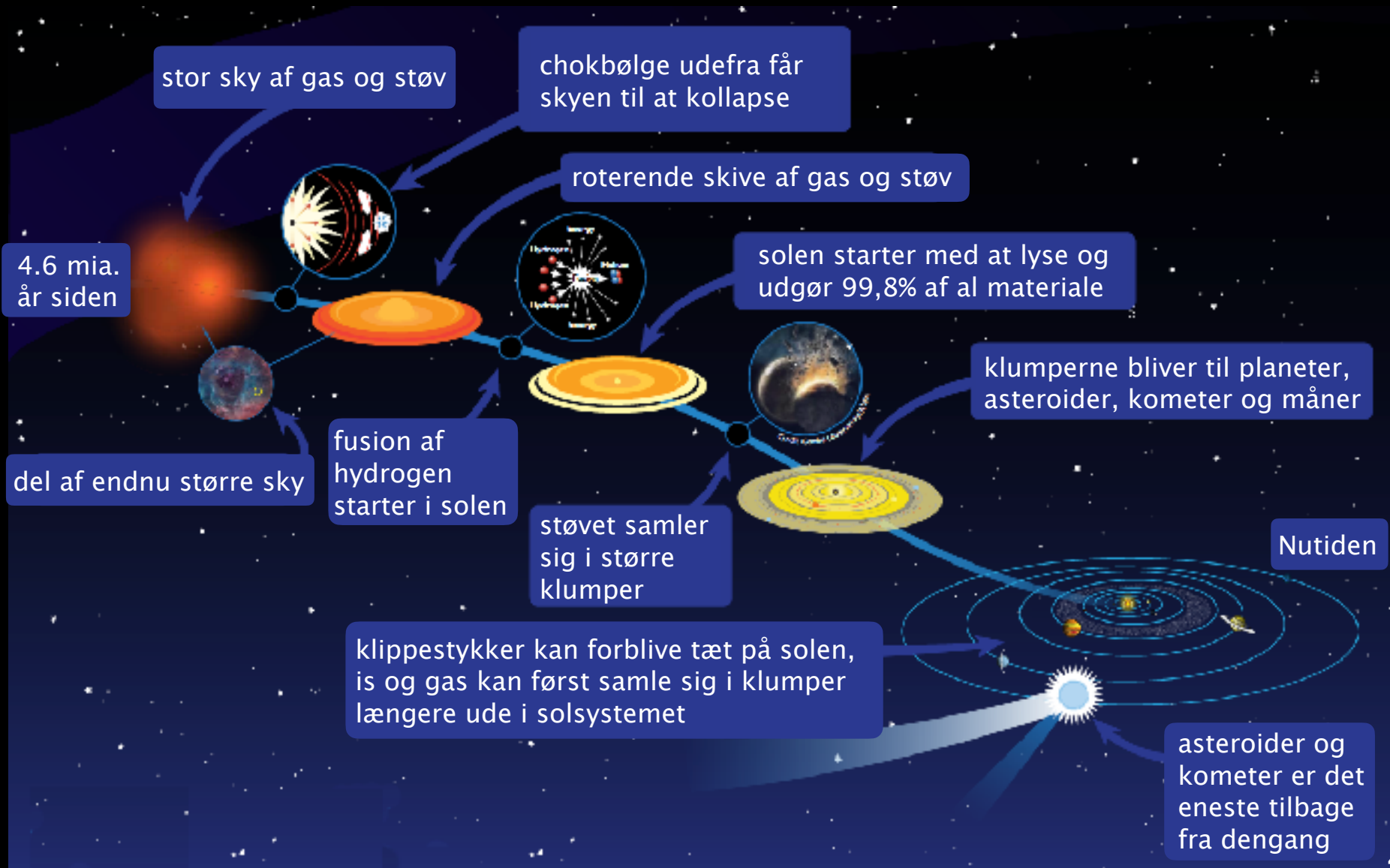
## Mennesker



Forskellene kan forklares med af **mekanismerne** bag

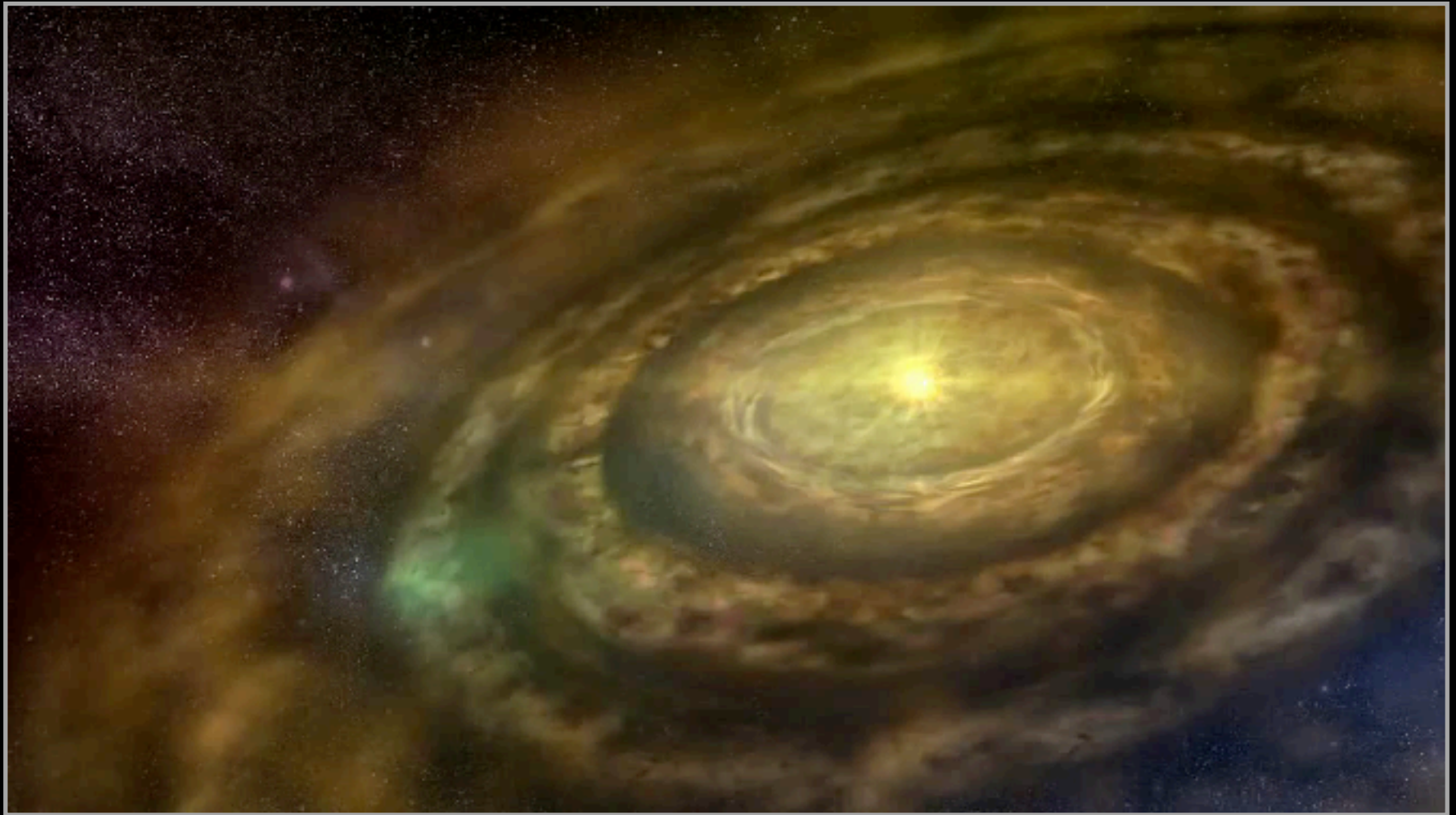
# Solsystemets og jordens skabelse

4.6 milliarder år siden



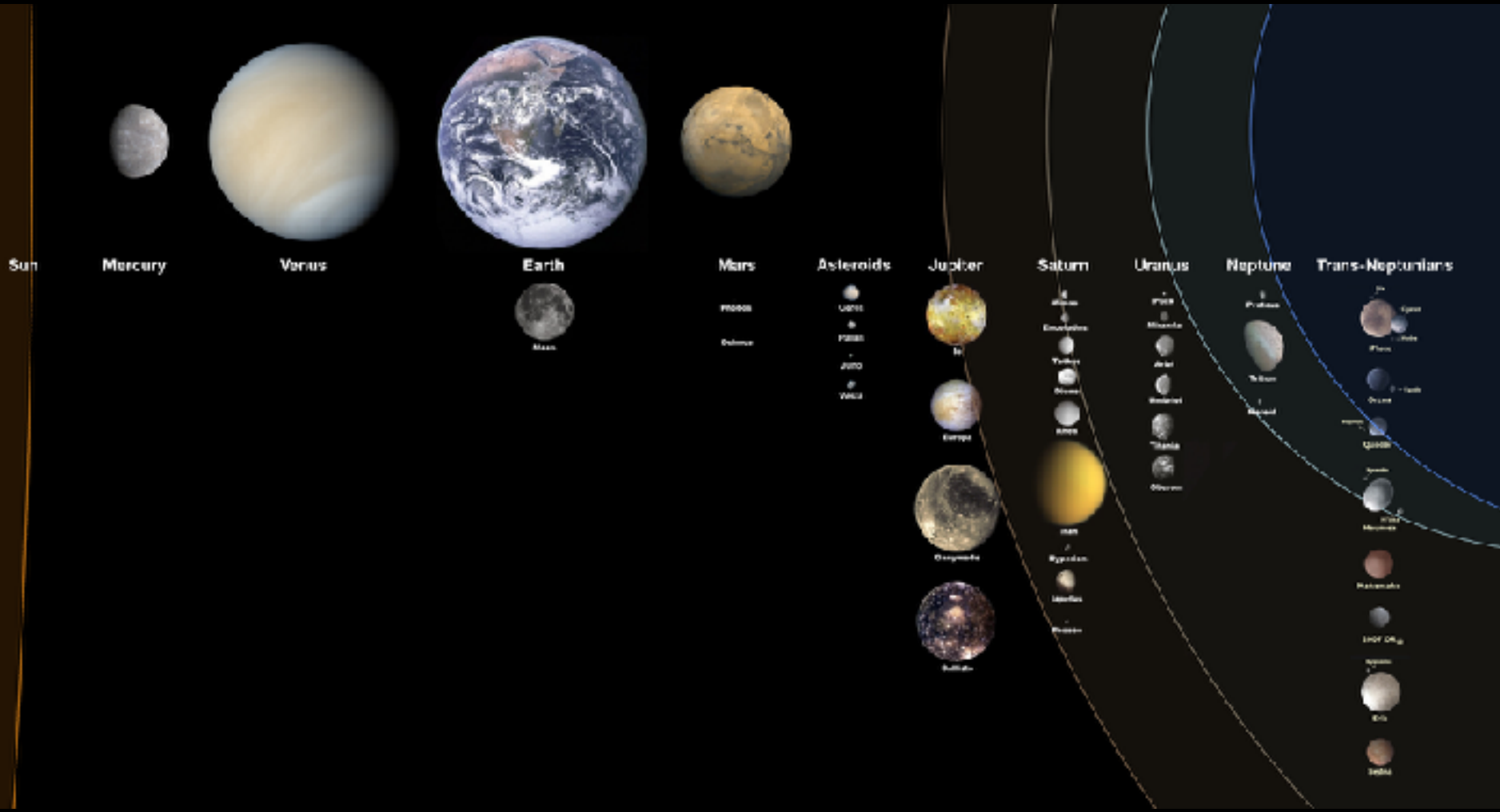
# Solsystemets og jordens skabelse

4.6 milliarder år siden

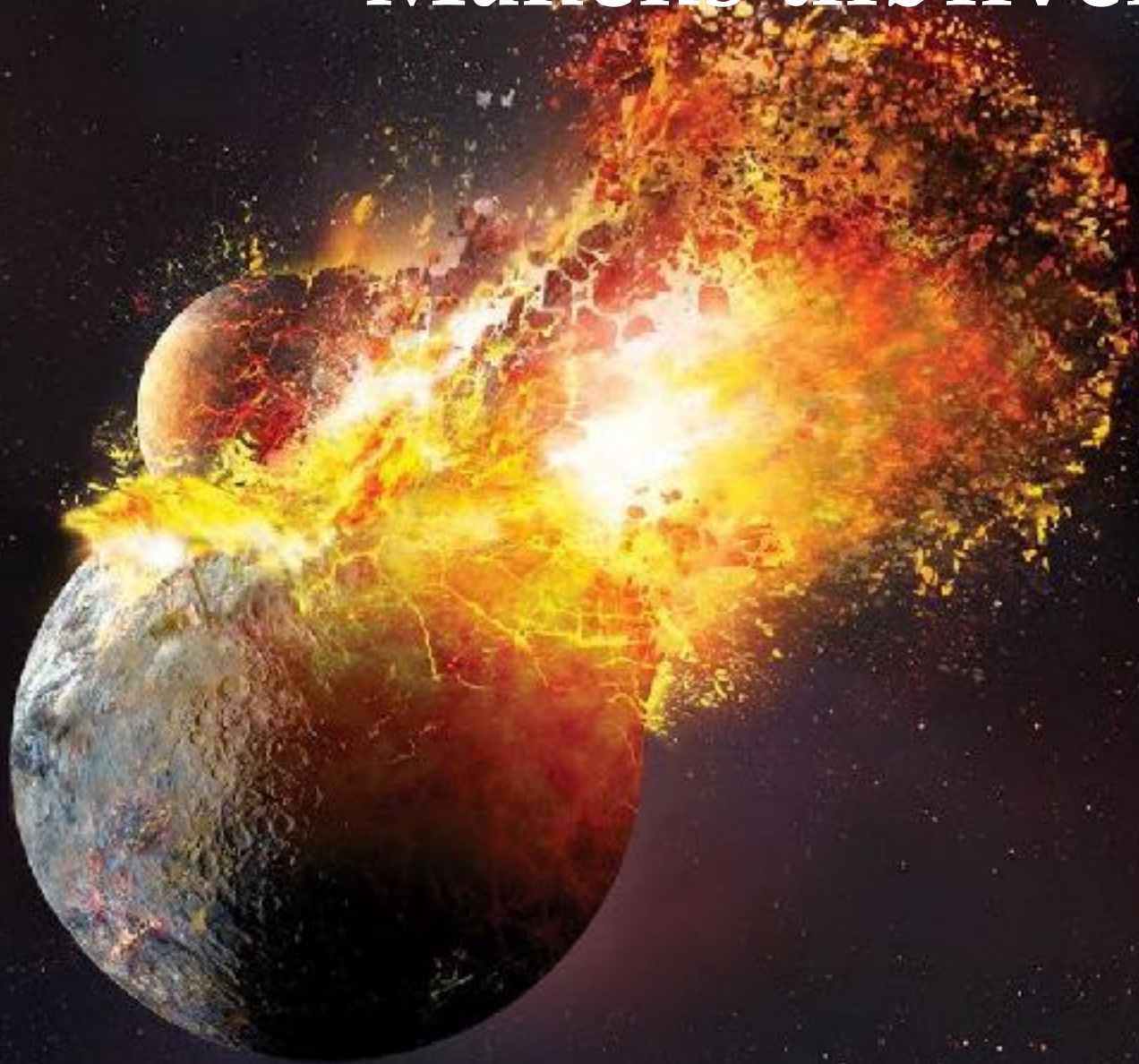




# Solsystemets planeter

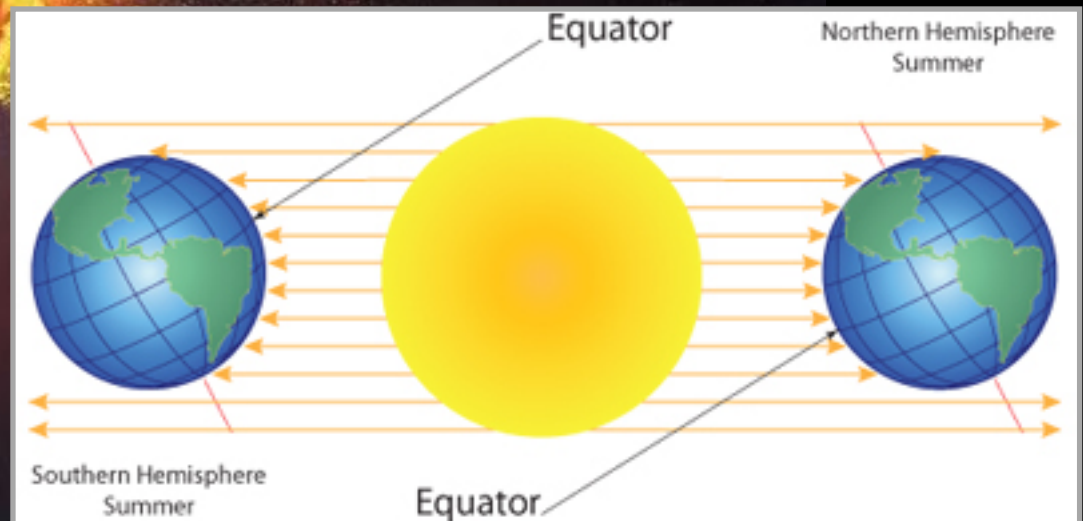
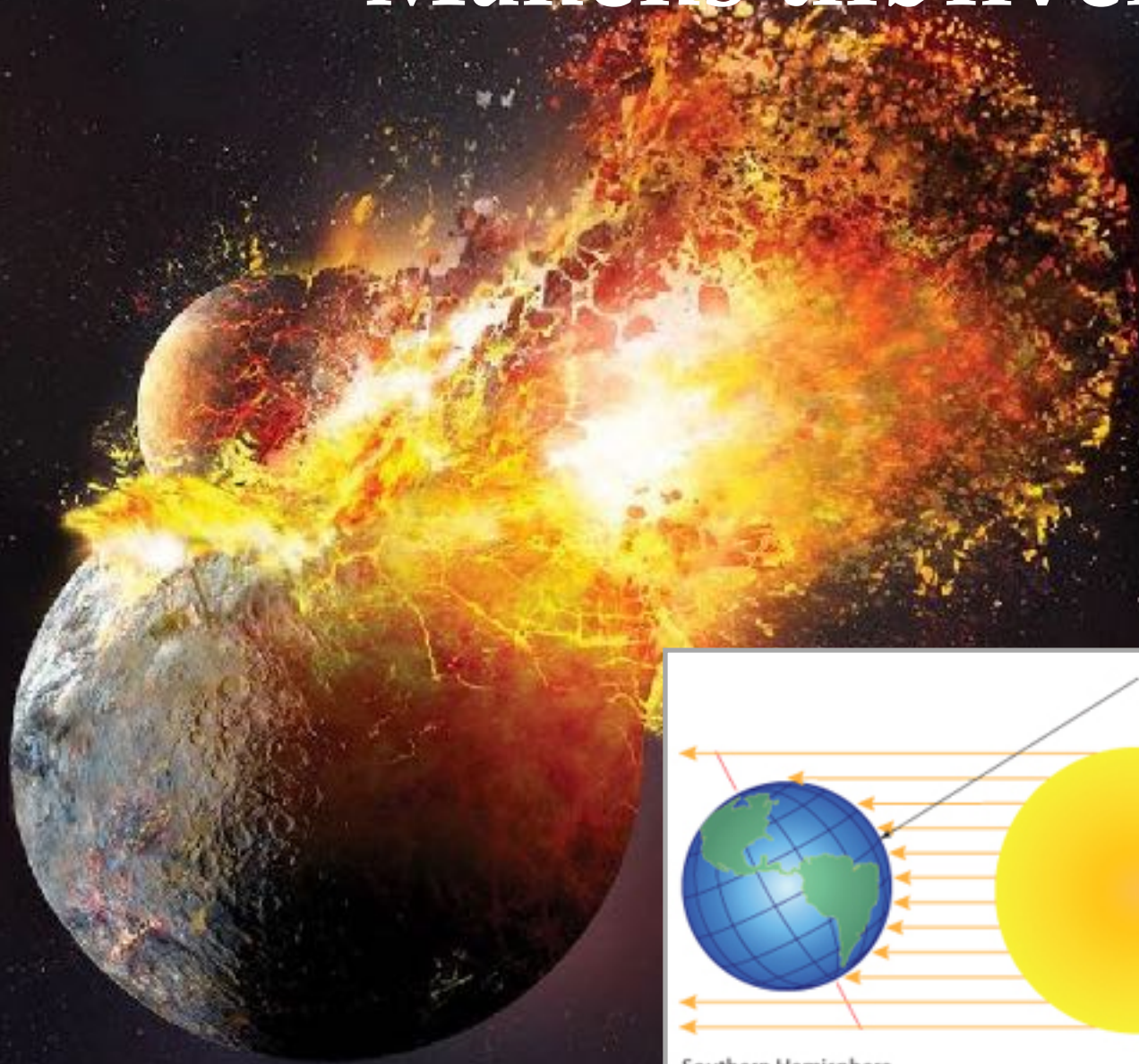


# Månens tilblivelse





# Månens tilblivelse





# Vandet kommer til Jordan



# Livet opstår på jorden

4 milliarder år siden

Al liv vi kender

- **kopierer** sig selv
- **befinder** sig i en **celle**
- **forbruger energi**



# Livet opstår på jorden

4 milliarder år siden

Al liv vi kender

- **kopierer** sig selv
- befinder sig i en **celle**
- forbruger **energi**



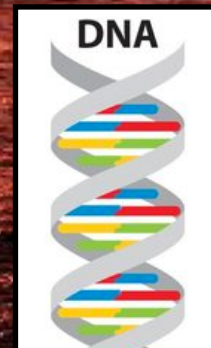
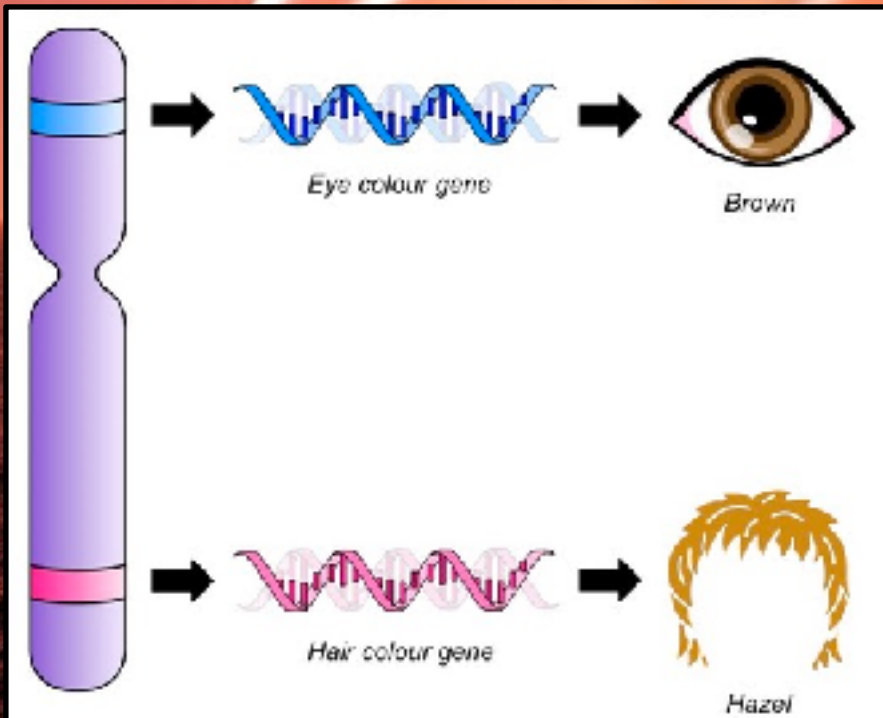
Kopiering





# Livet opstår på jorden

4 milliarder år siden

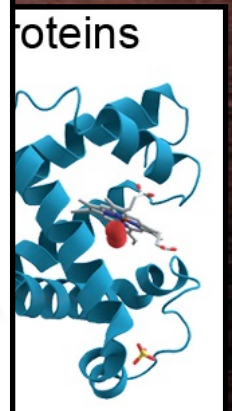
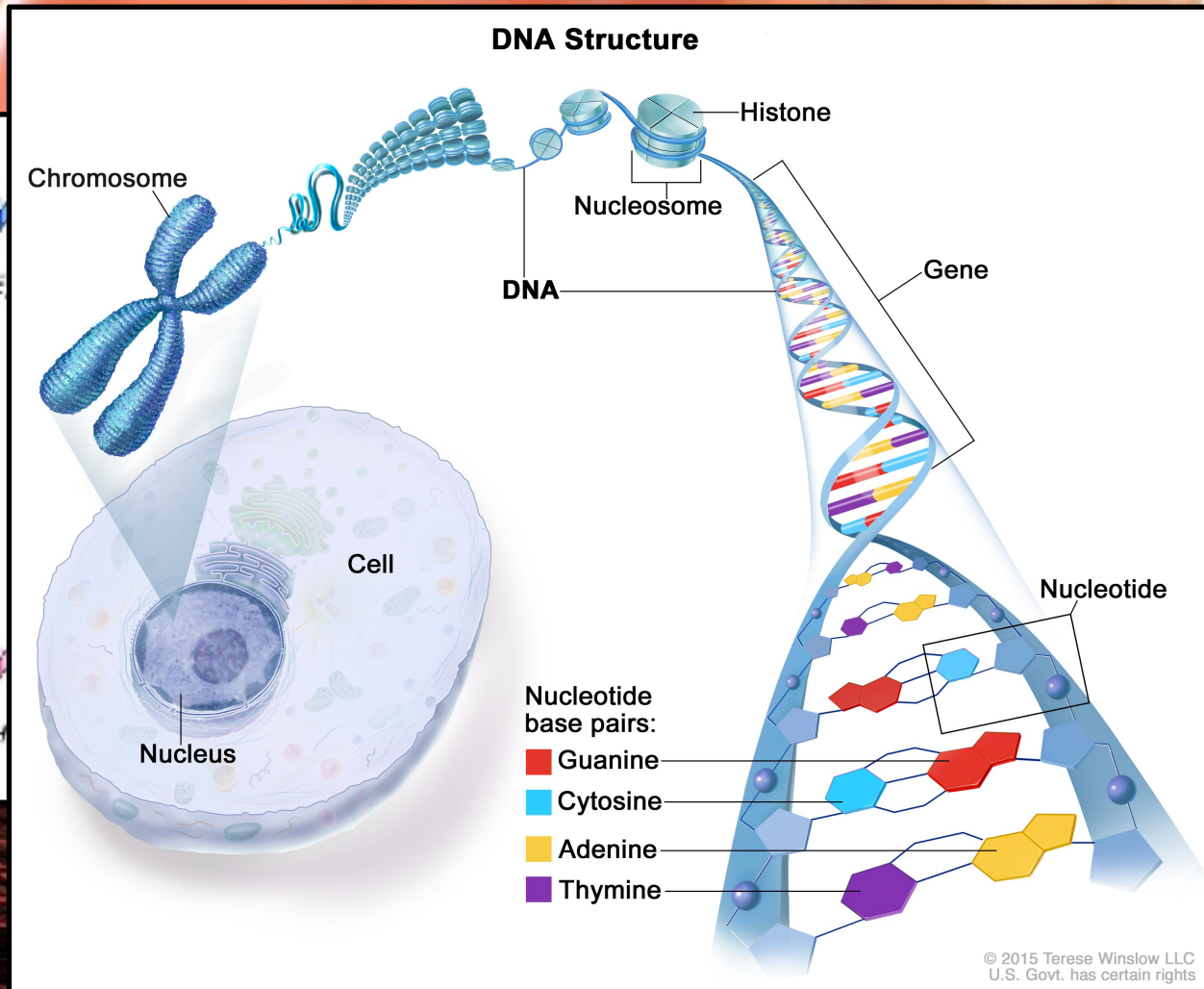
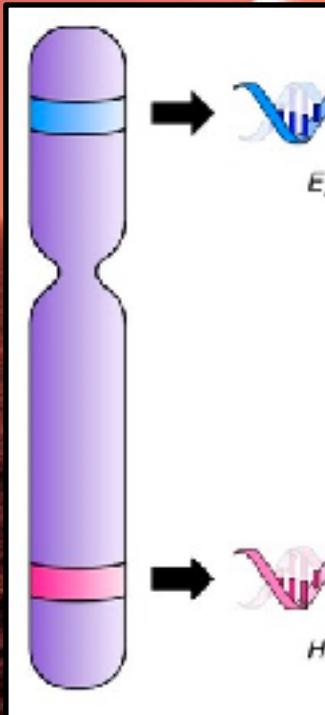


Kopiering



# Livet opstår på jorden

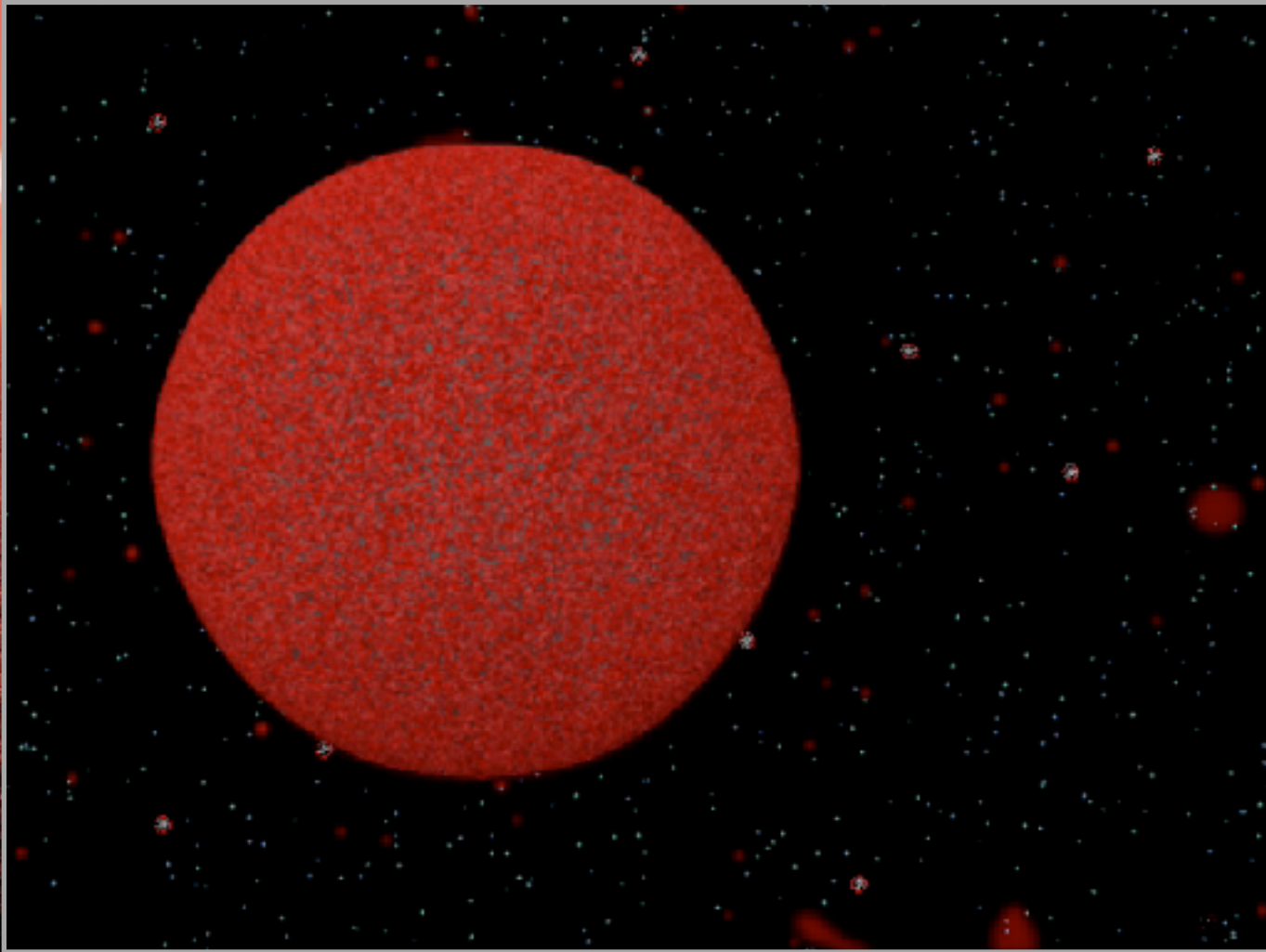
4 milliarder år siden





# Livet opstår på jorden

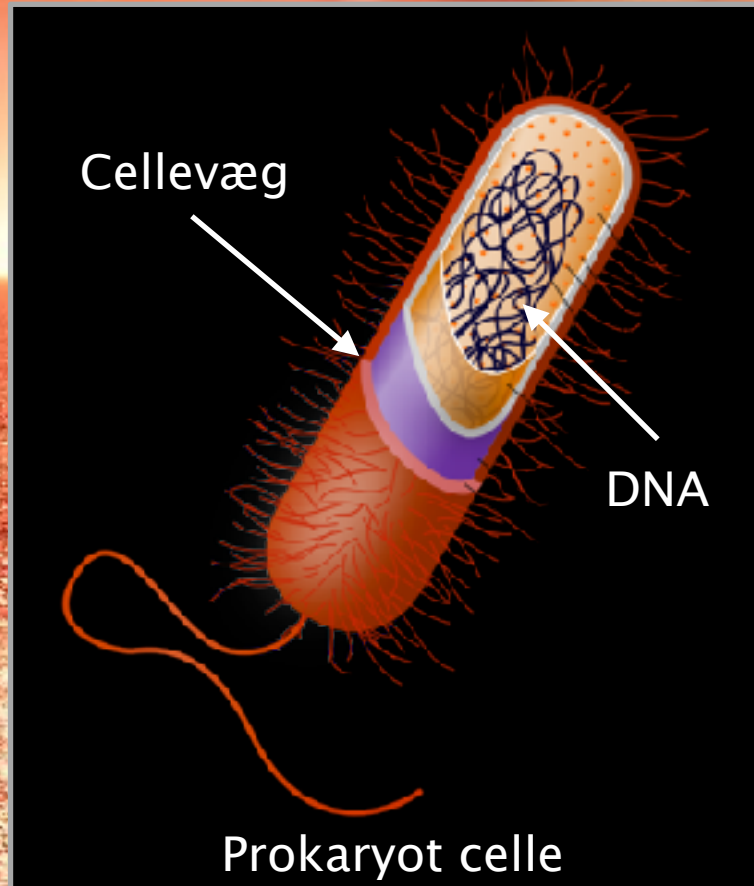
4 milliarder år siden





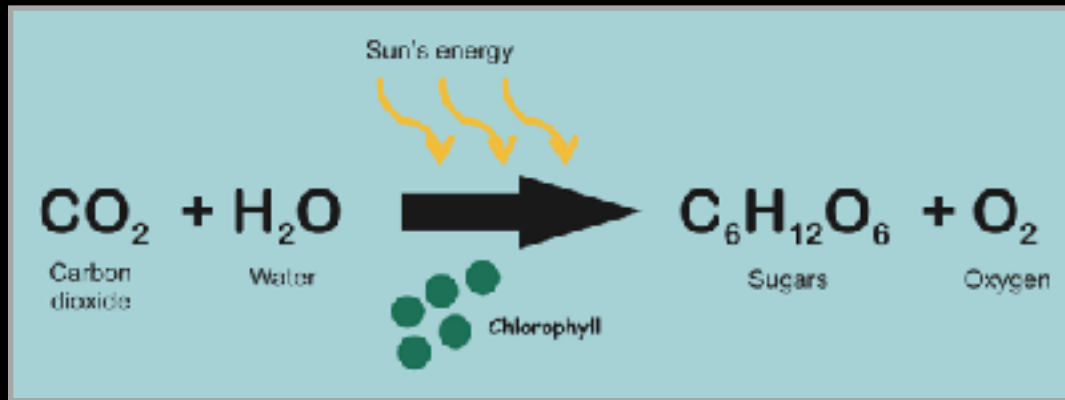
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4 milliarder år siden

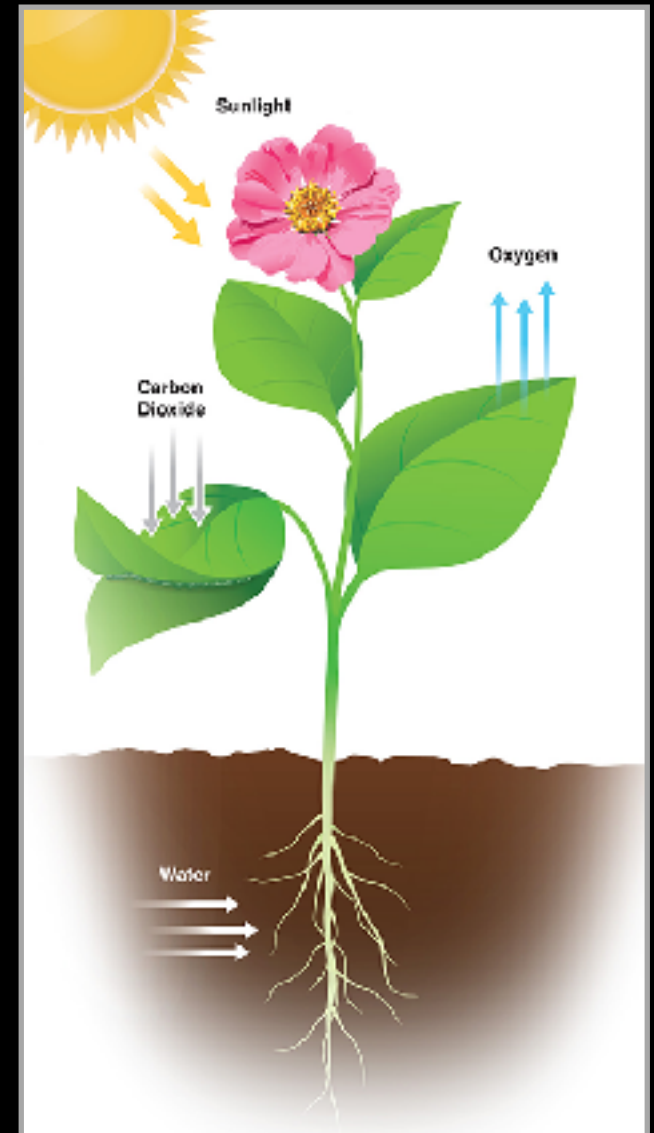


# Fotosyntese - Energi til liv

~3.0-3.5 milliarder år siden

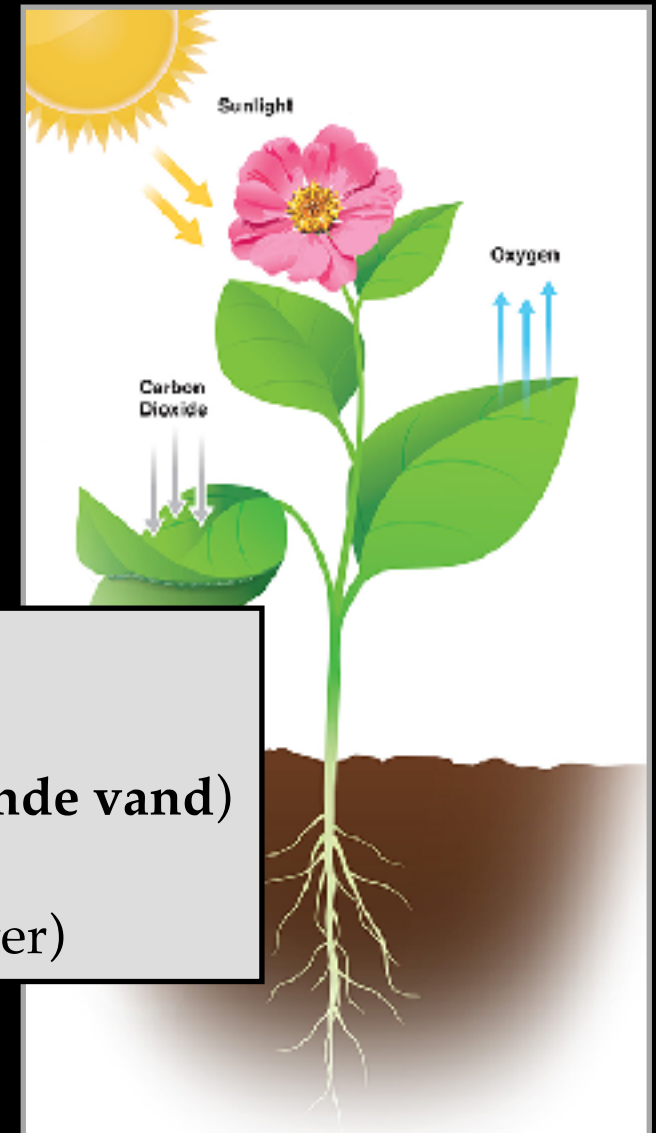
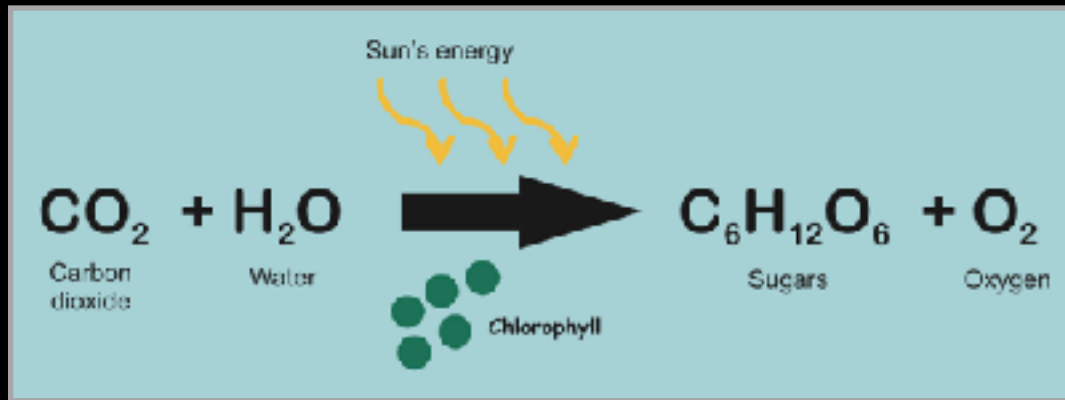


- På 1 m<sup>2</sup> på jorden kommer der:
- Indefra: < 0.1 Watt (varme)
  - Fra solen: 340 Watt



# Fotosyntese - Energi til liv

~3.0-3.5 milliarder år siden

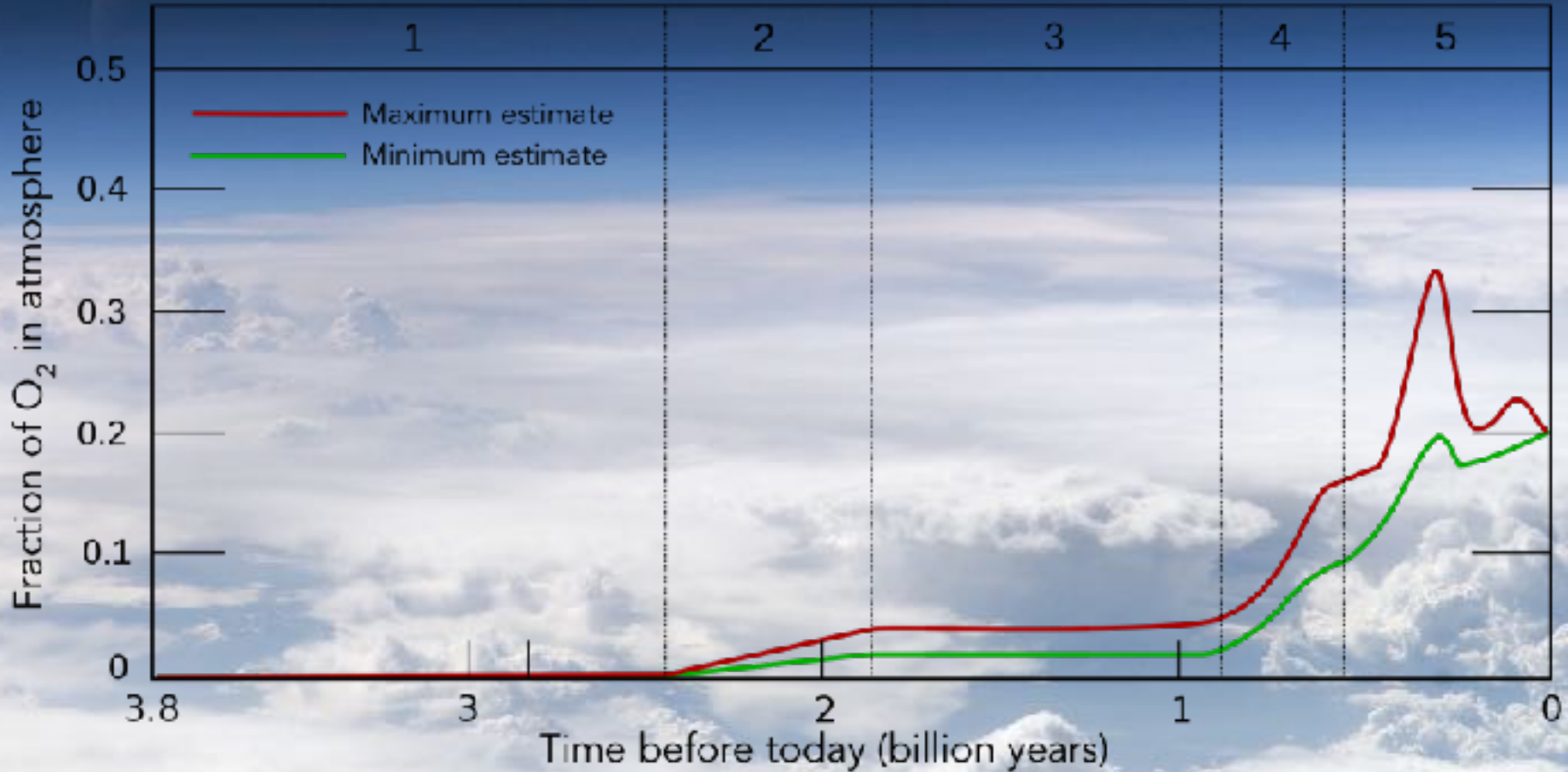


Fotosyntesen er helt central af tre grunde:

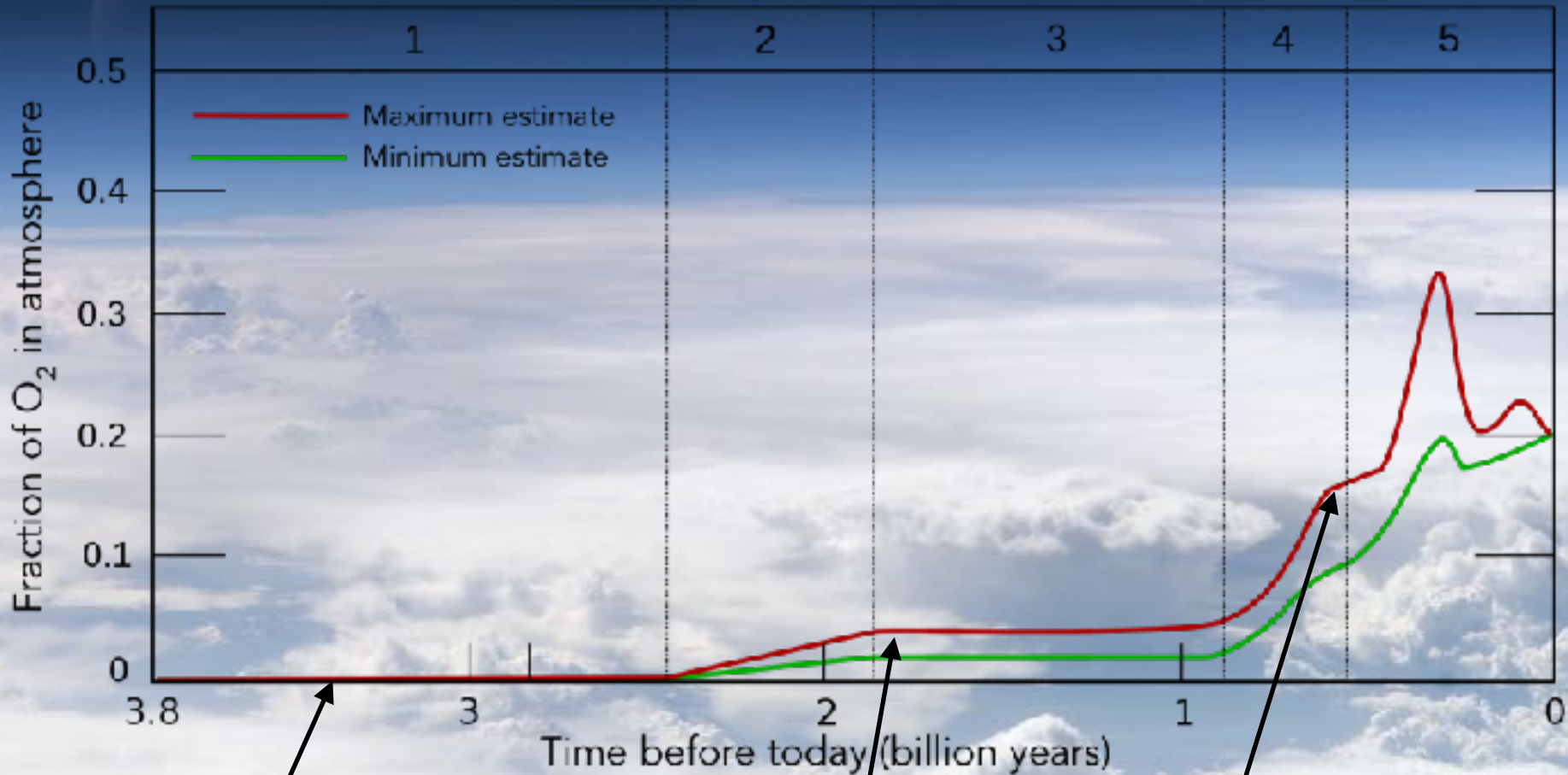
- De atomer der indgår, er **overalt**
- Den definerer den beboelige zone (**flydende vand**)
- Den fortæller hvordan **O<sub>2</sub>** kommer til  
(og en måde at lede efter liv på exoplaneter)



# Oxygen i atmosfæren



# Oxygen i atmosfæren



Kun de simpleste celler eksisterer.

Grundlaget for flercellet liv (Eukaryoter) kommer til.

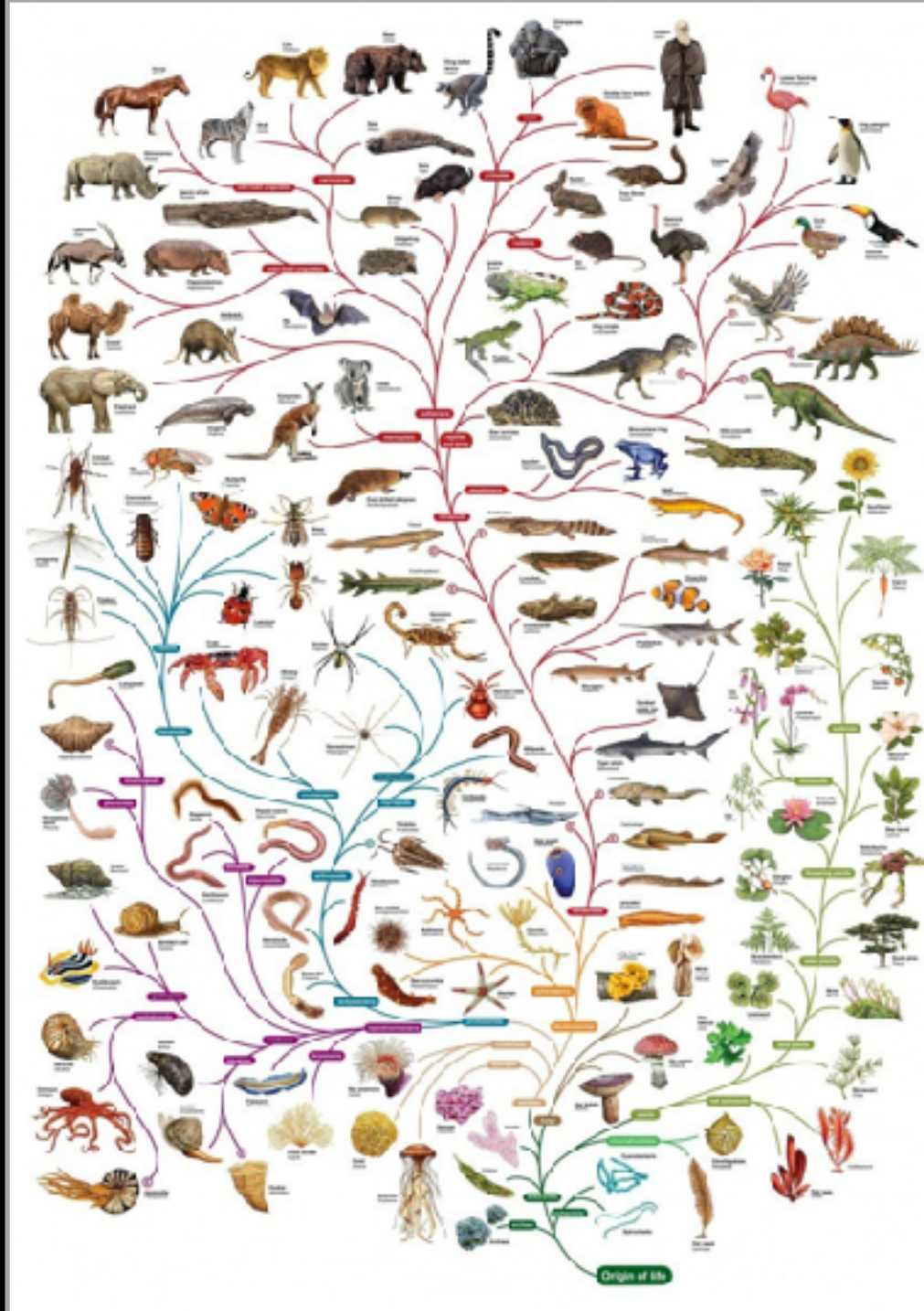
Store og avancerede planter/dyr udvikles.

# Liv på Jorden

Så følger en rivende udvikling:

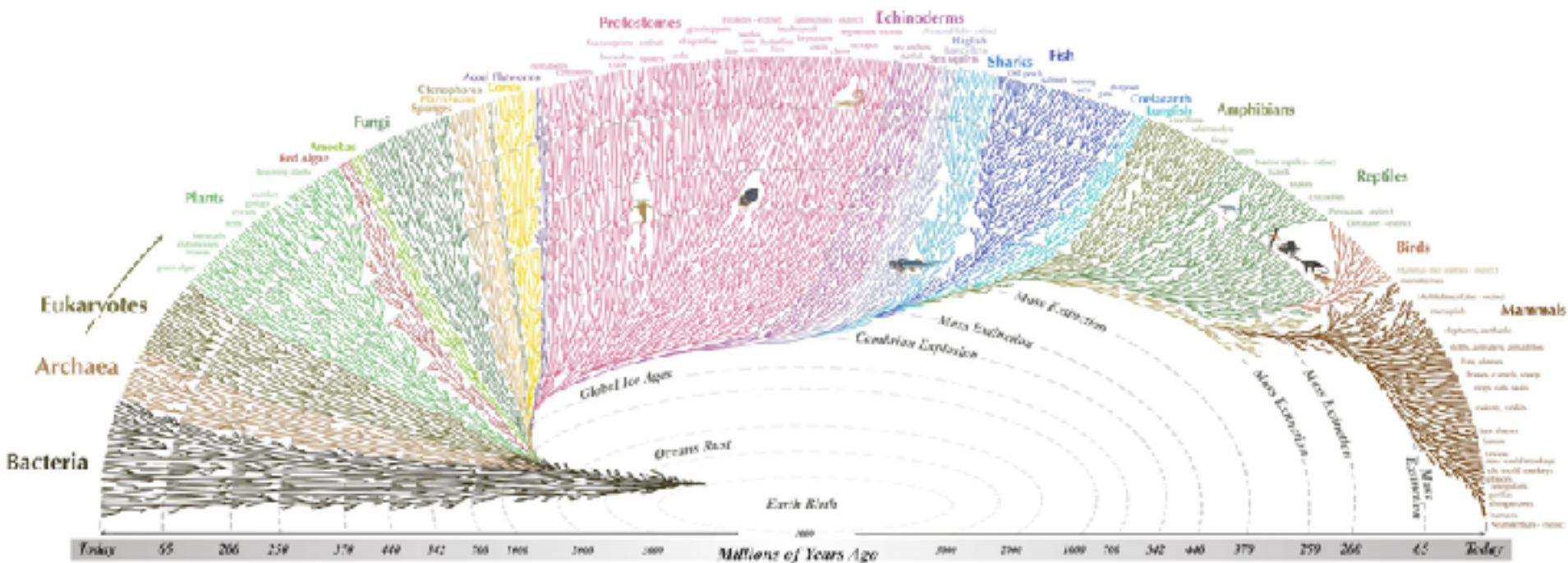
- Flercellet liv: **1.000 mio. år.**
- Fisk: **500 mio. år.**
- Planter på land: **500 mio. år.**
- Dinosaurer: **250 mio. år.**
- Pattedyr: **200 mio. år.**

I dag er der **10-14 millioner arter**





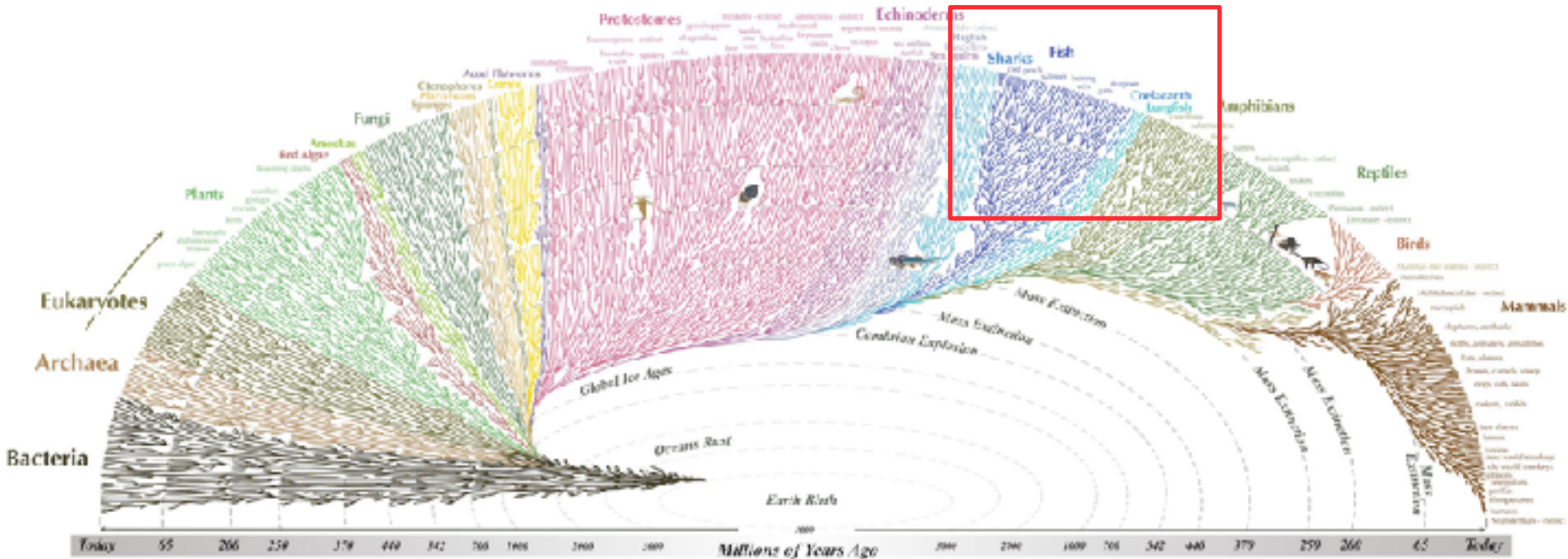
# Livets familietræ



NI. De major and many of the major living branches of life are shown in this diagram, but only a few of those that have gone extinct are shown. Example:  dinosaur

[Se mere på evogeneao](http://evogeneao)

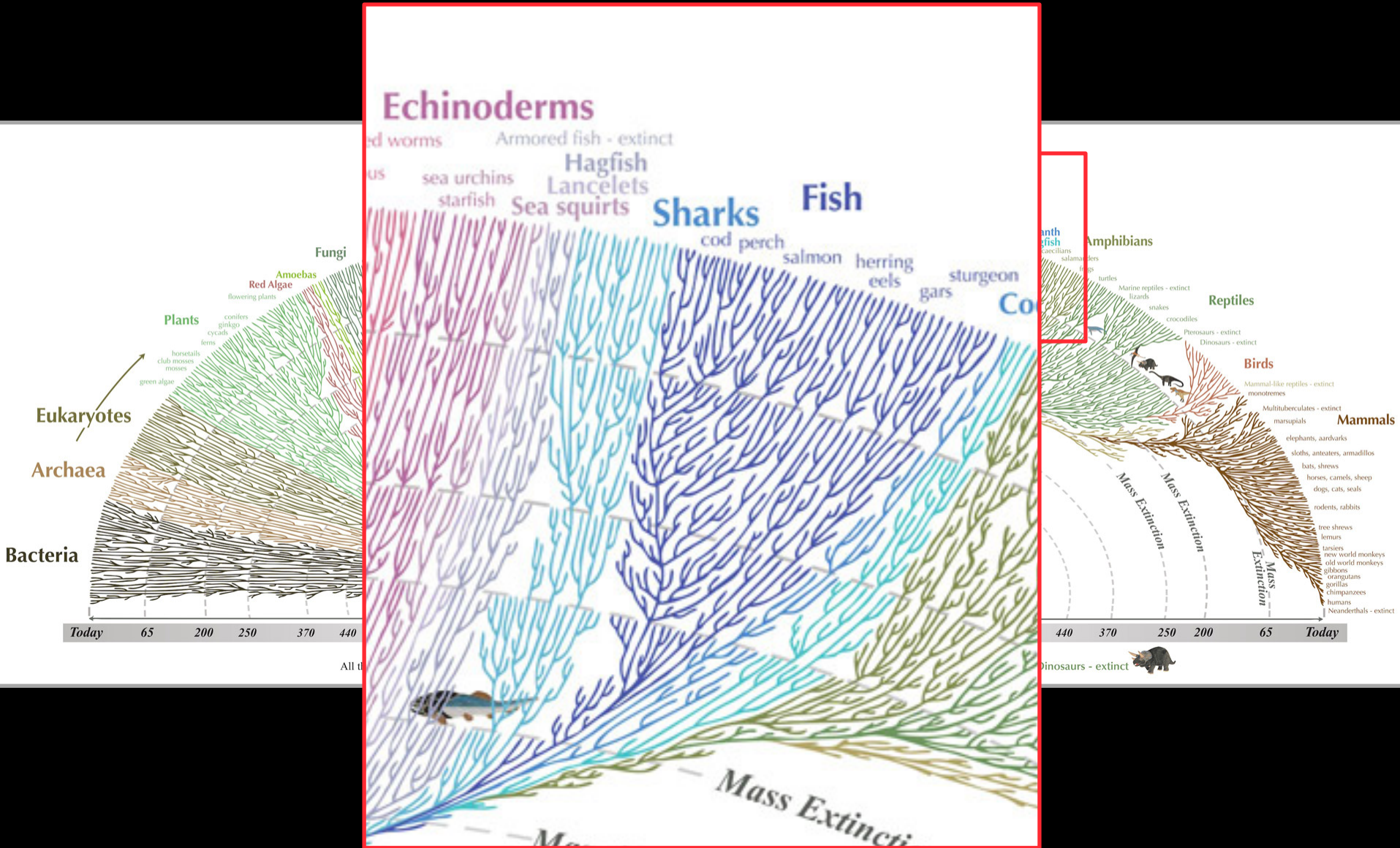
# Livets familietræ



NI. De major and many of the minor living branches of life are shown in this diagram, but only a few of those that have gone extinct are shown. Example:  extinct

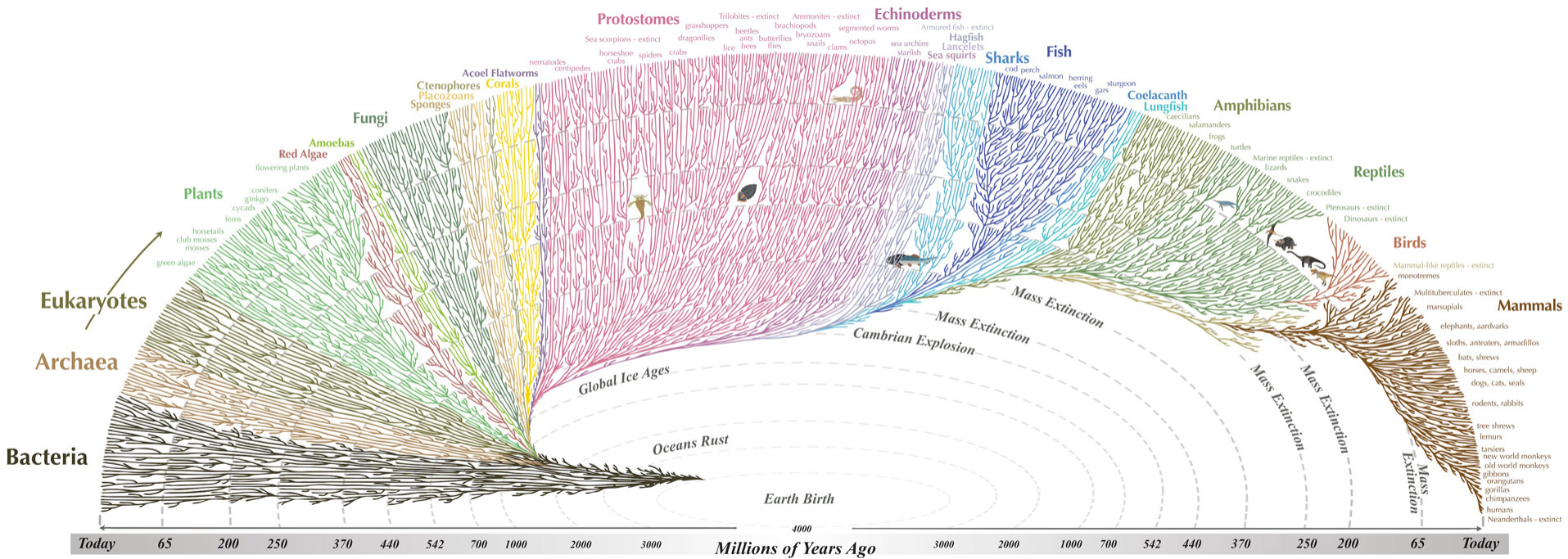



# Livets familietræ



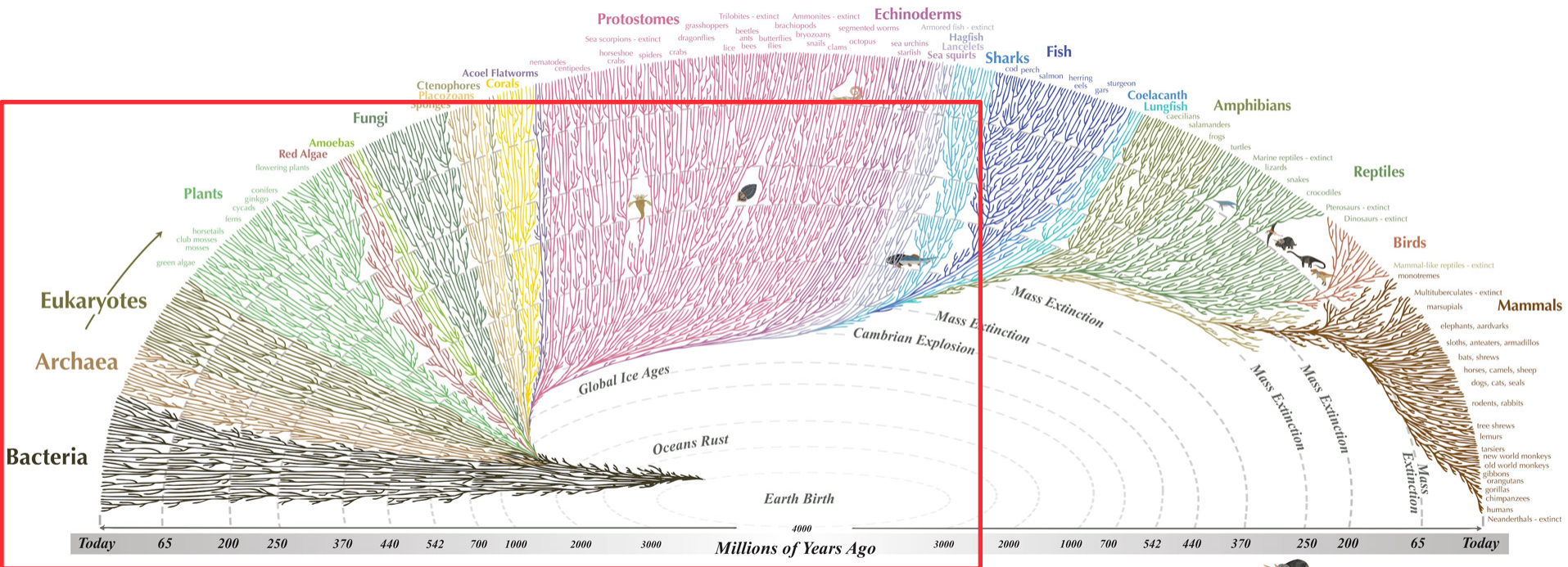



# Livets familietræ



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct 

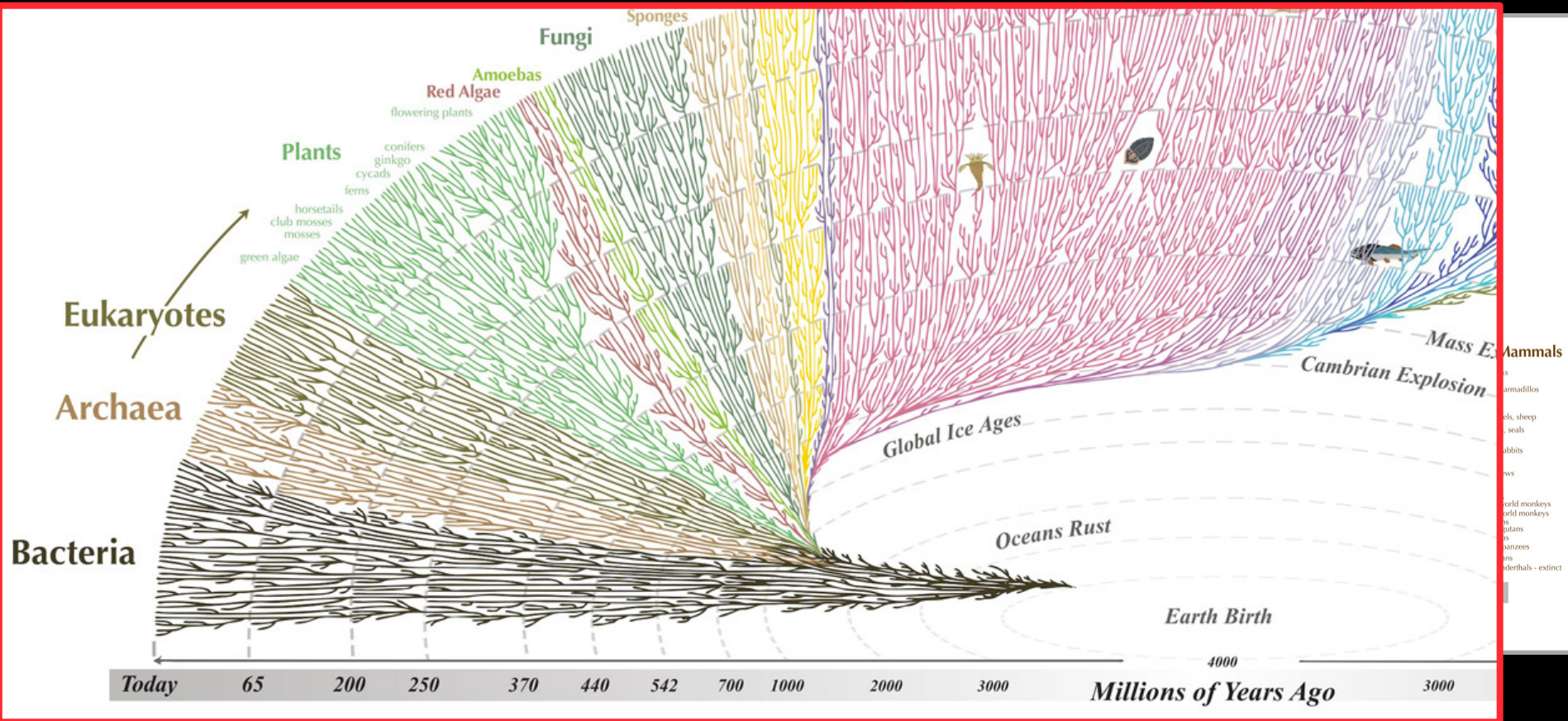
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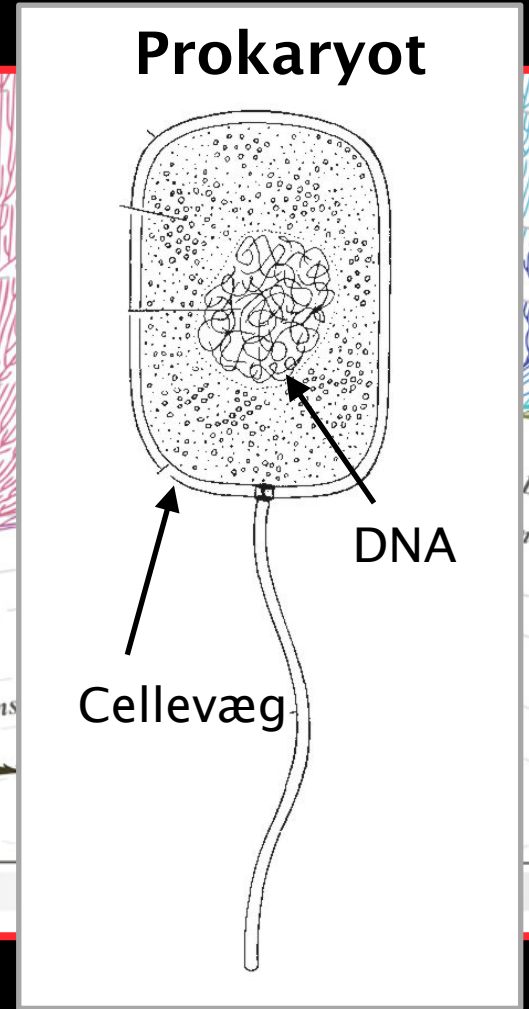
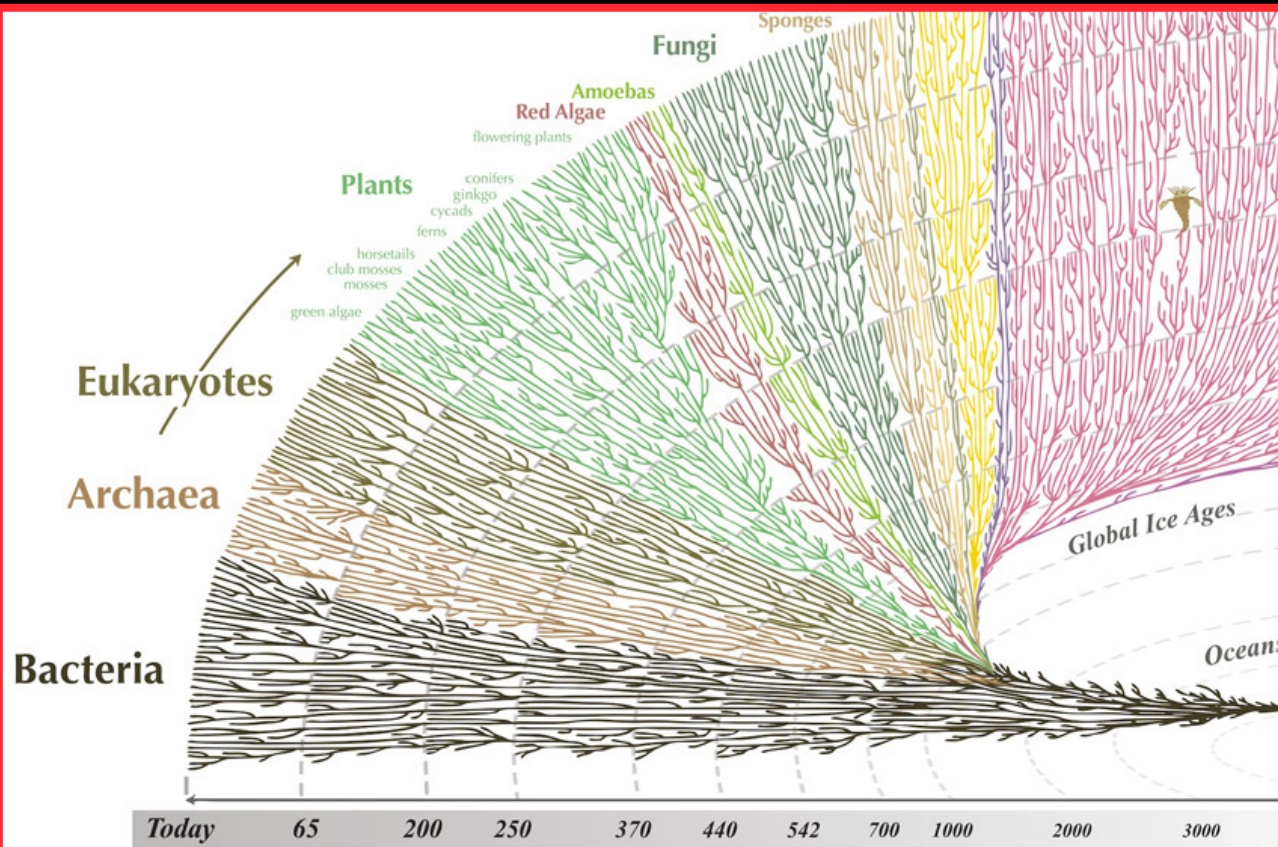


# Livets familietræ



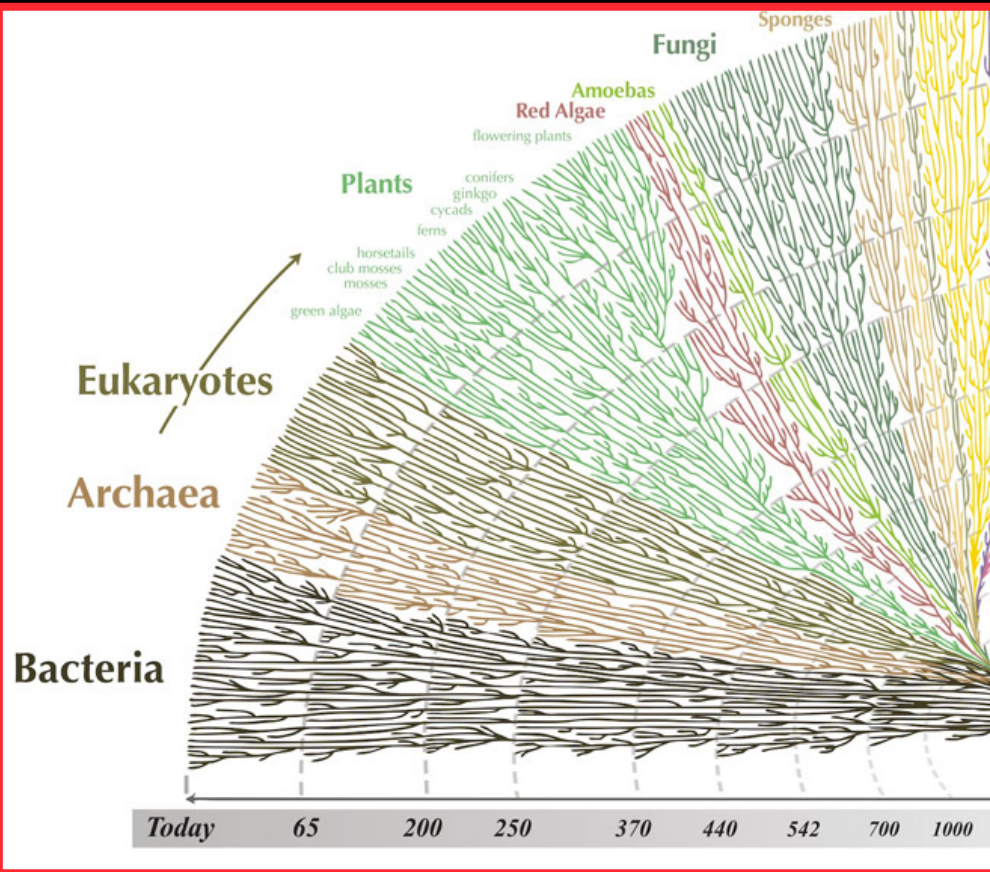


# Livets familietræ

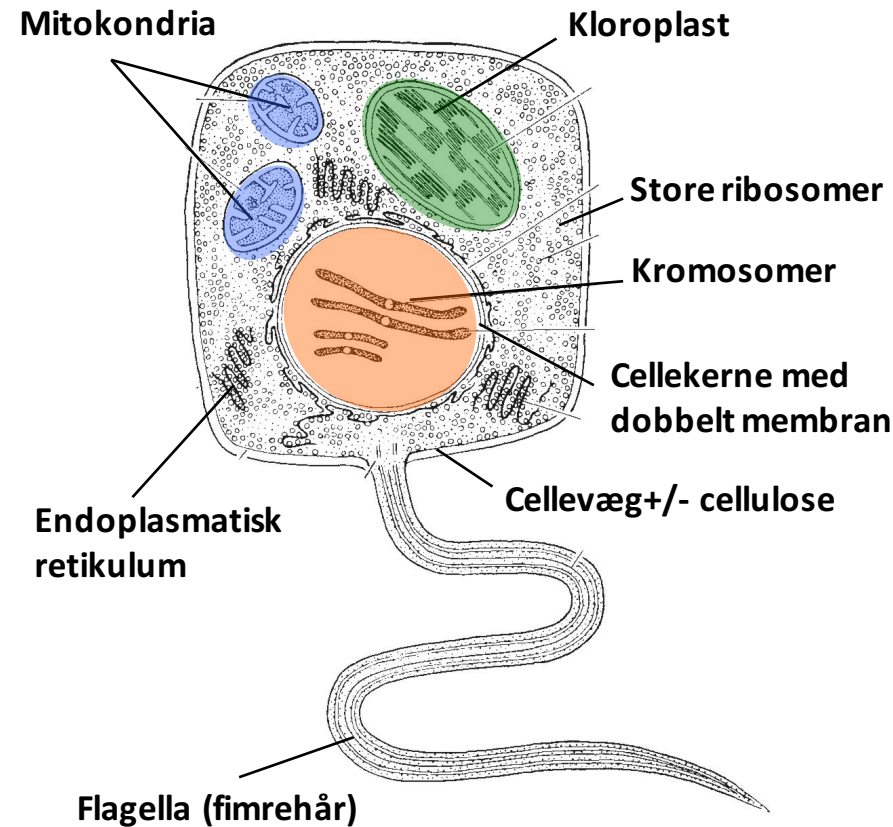


**Mammals**  
s  
armadillos  
els, sheep  
seals  
rabbits  
sws  
wild monkeys  
wild monkeys  
gulates  
sanzeees  
ms  
idherthals - extinct

# Livets familietræ

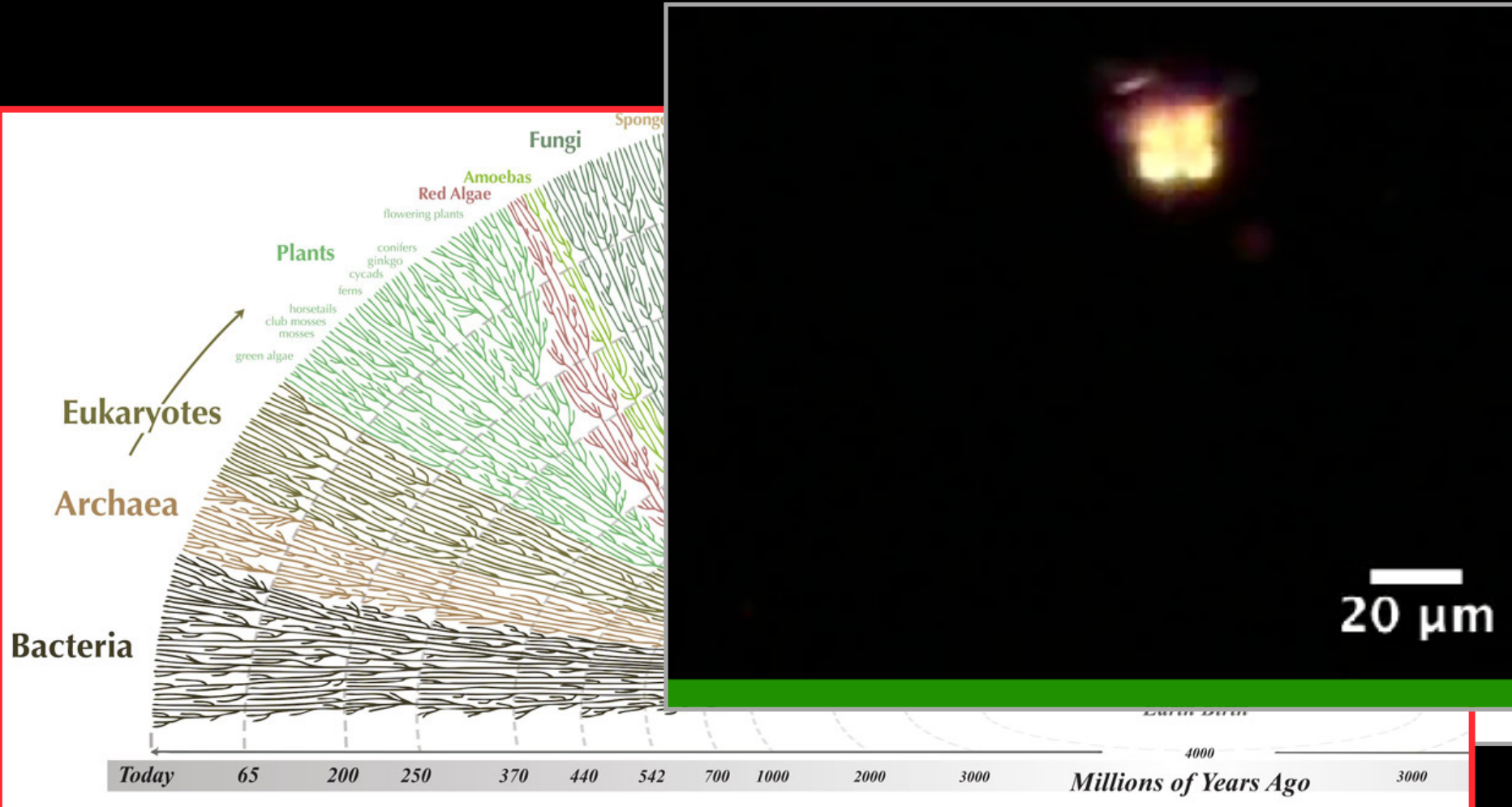


## Eukaryot



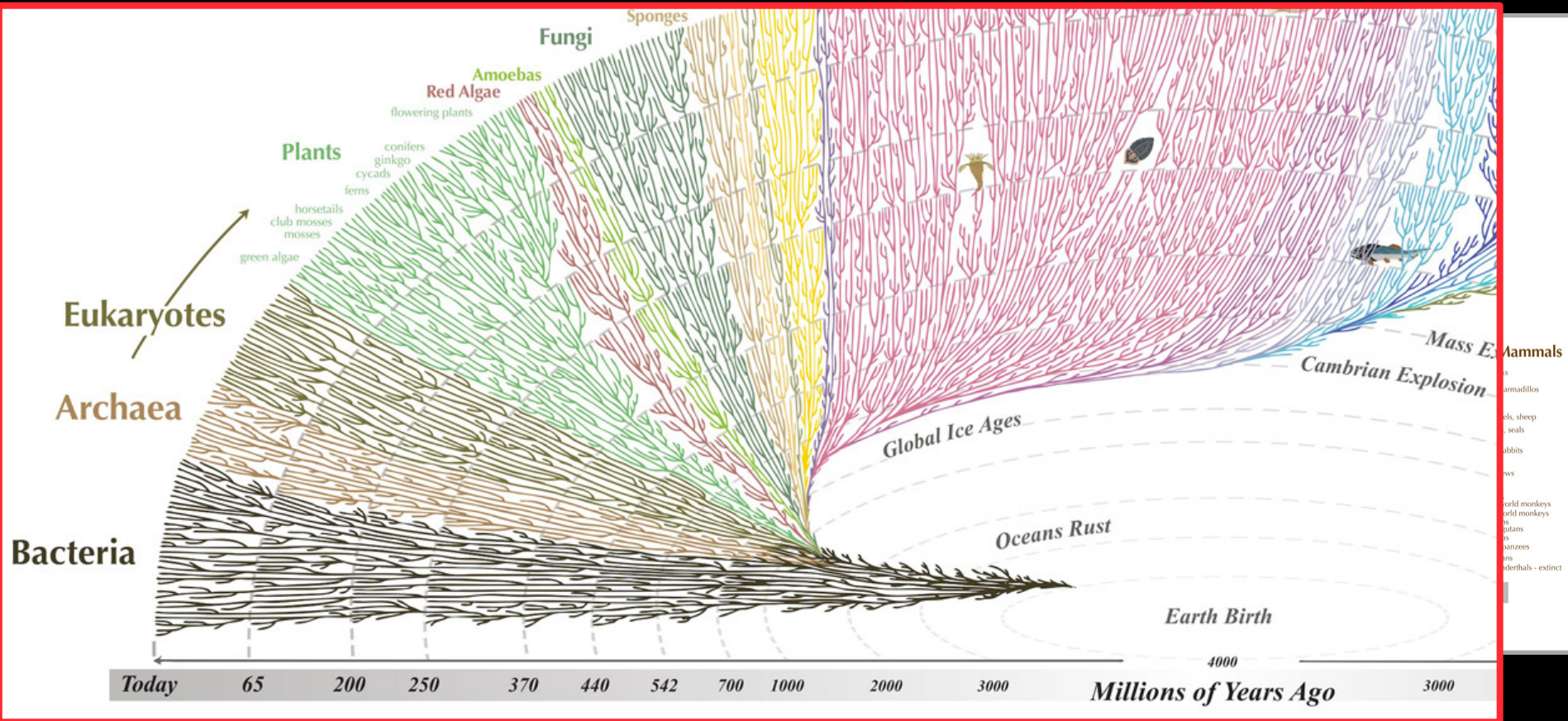


# Livets familietræ



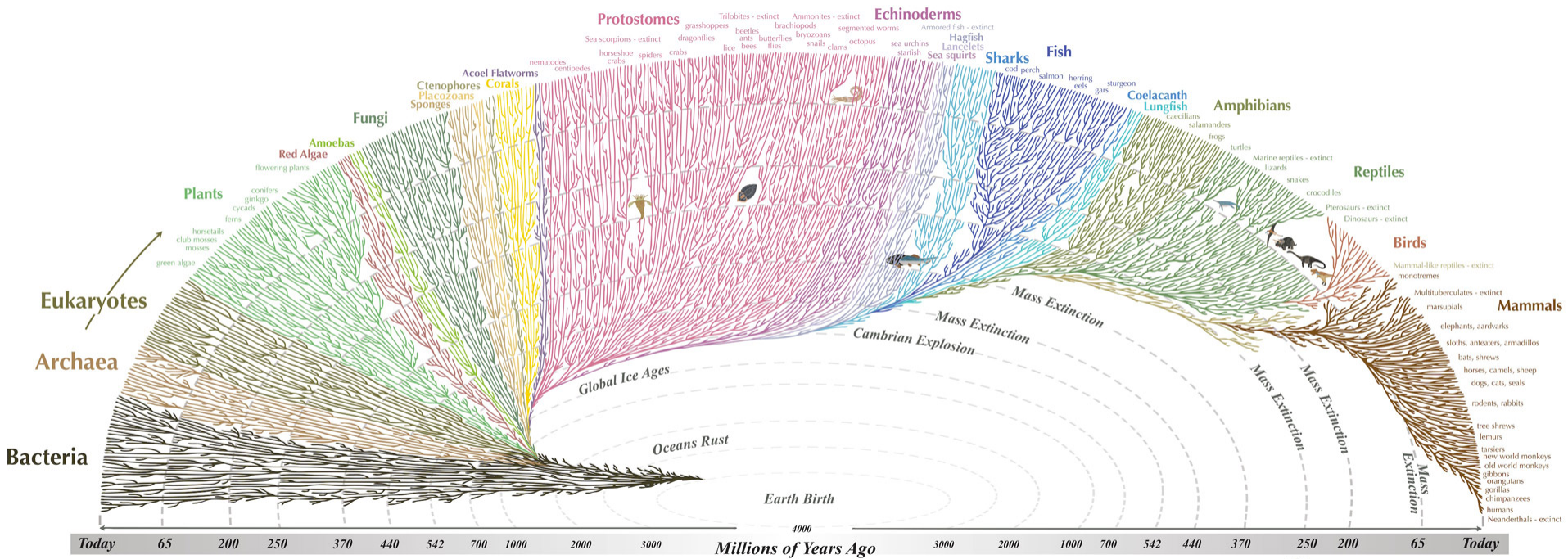



# Livets familietræ



Alle levende organismer har **celler** og **DNA** til fælles, arvet fra det første liv.

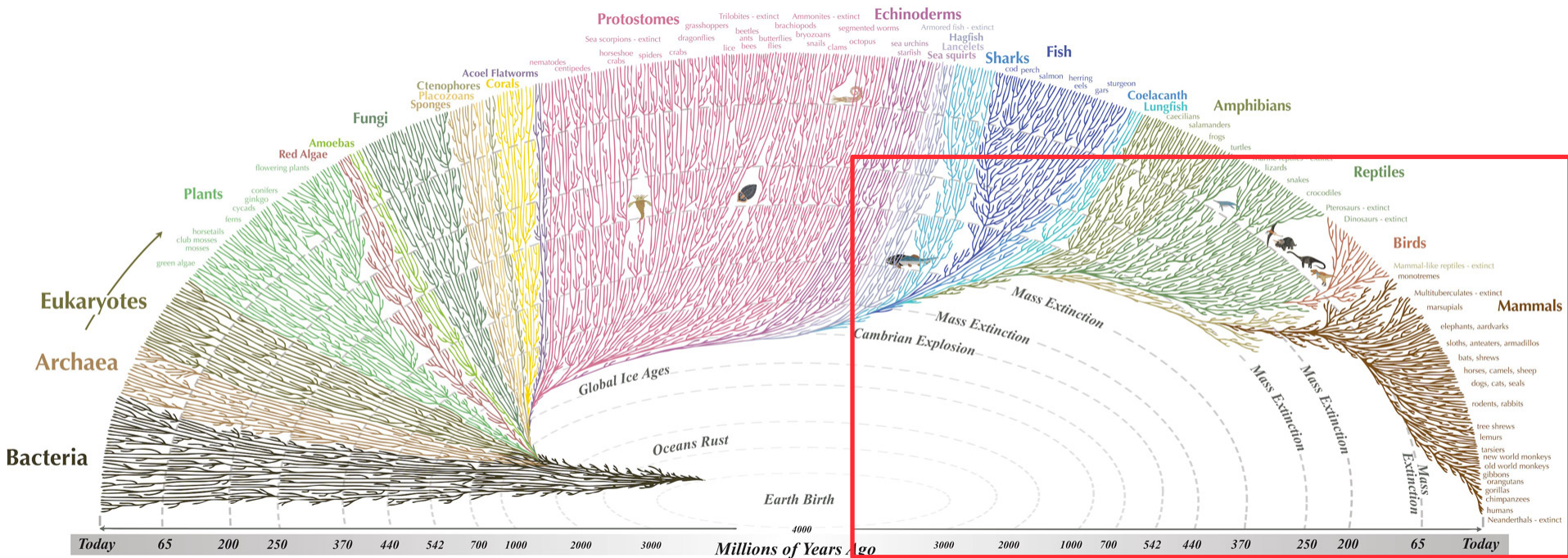
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Dinosaurernes uddøen...  
...pattedyrenes chance!



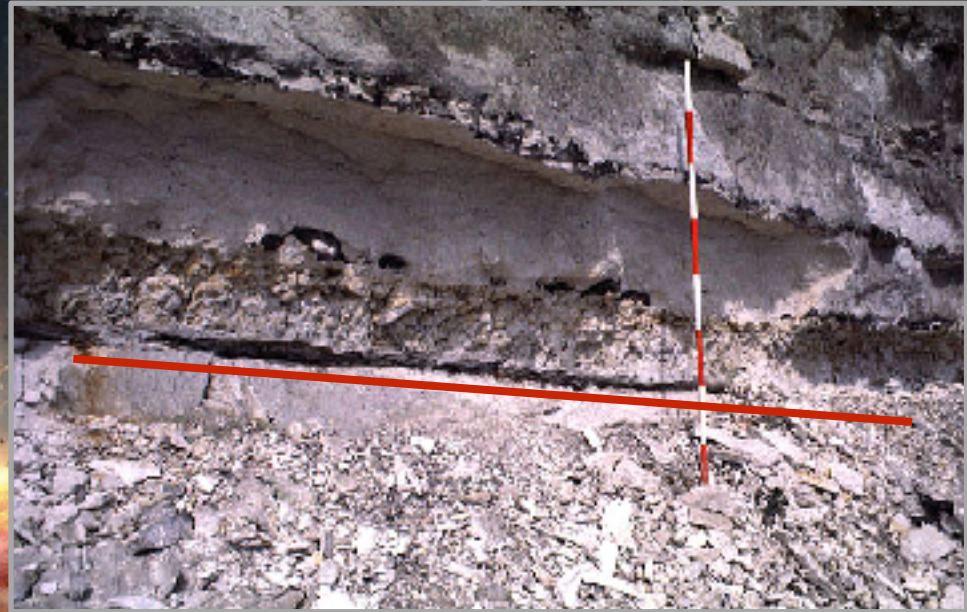
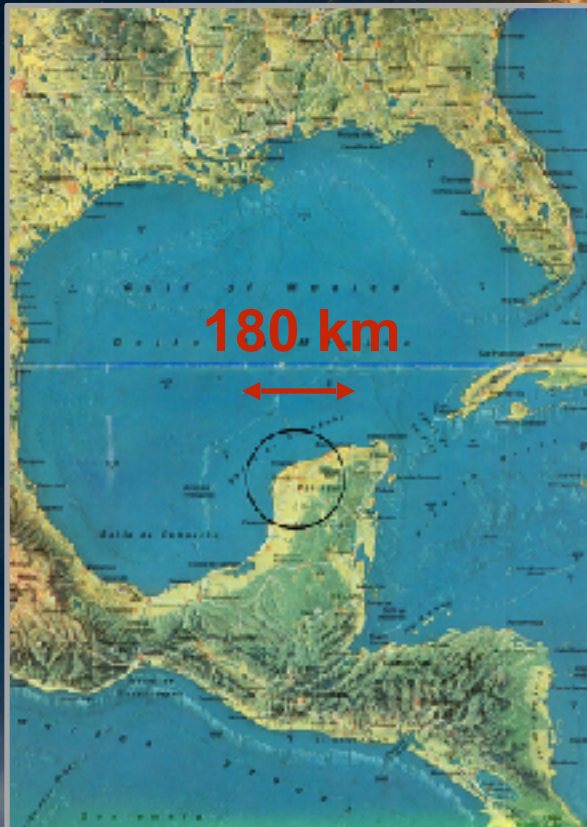


# Dinosaurernes uddøen... ...pattedyrenes chance!





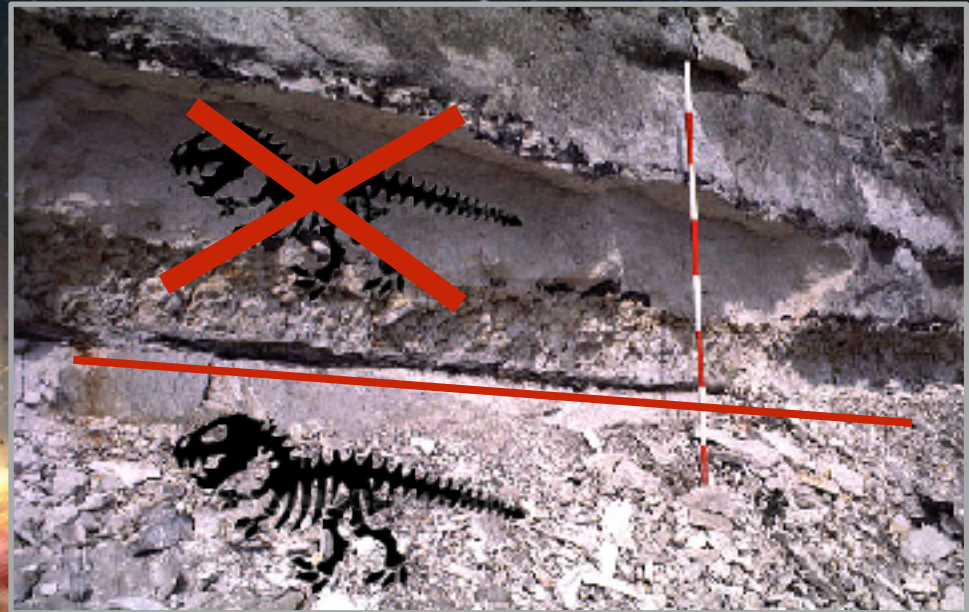
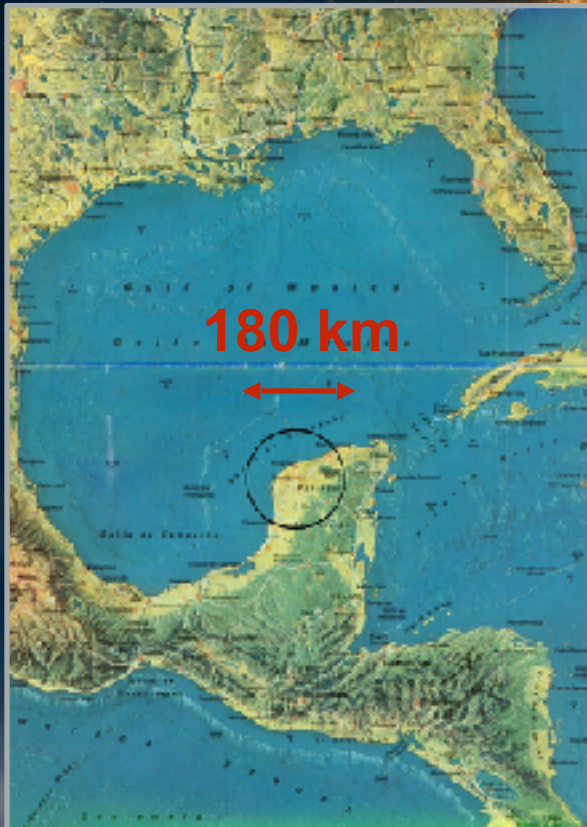
# Dinosaurusernes uddøen... ...pattedyrenes chance!



Det sorte lag blev lagt for **65 millioner år siden**.  
Indeholder iridium, som astroider har, men  
jordens skorpe ikke har.  
**Det resulterede i 75% af alle arters død.**

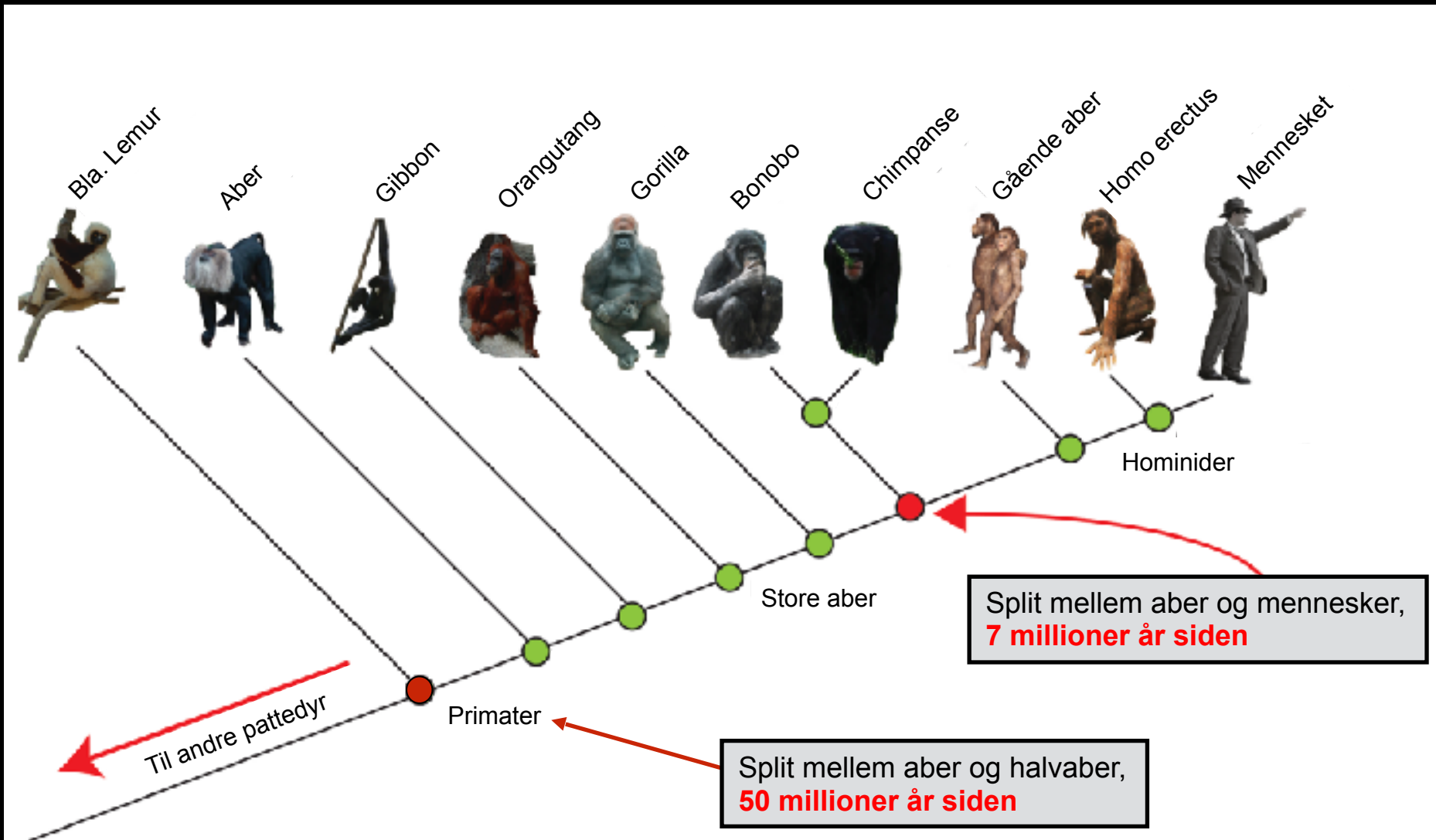


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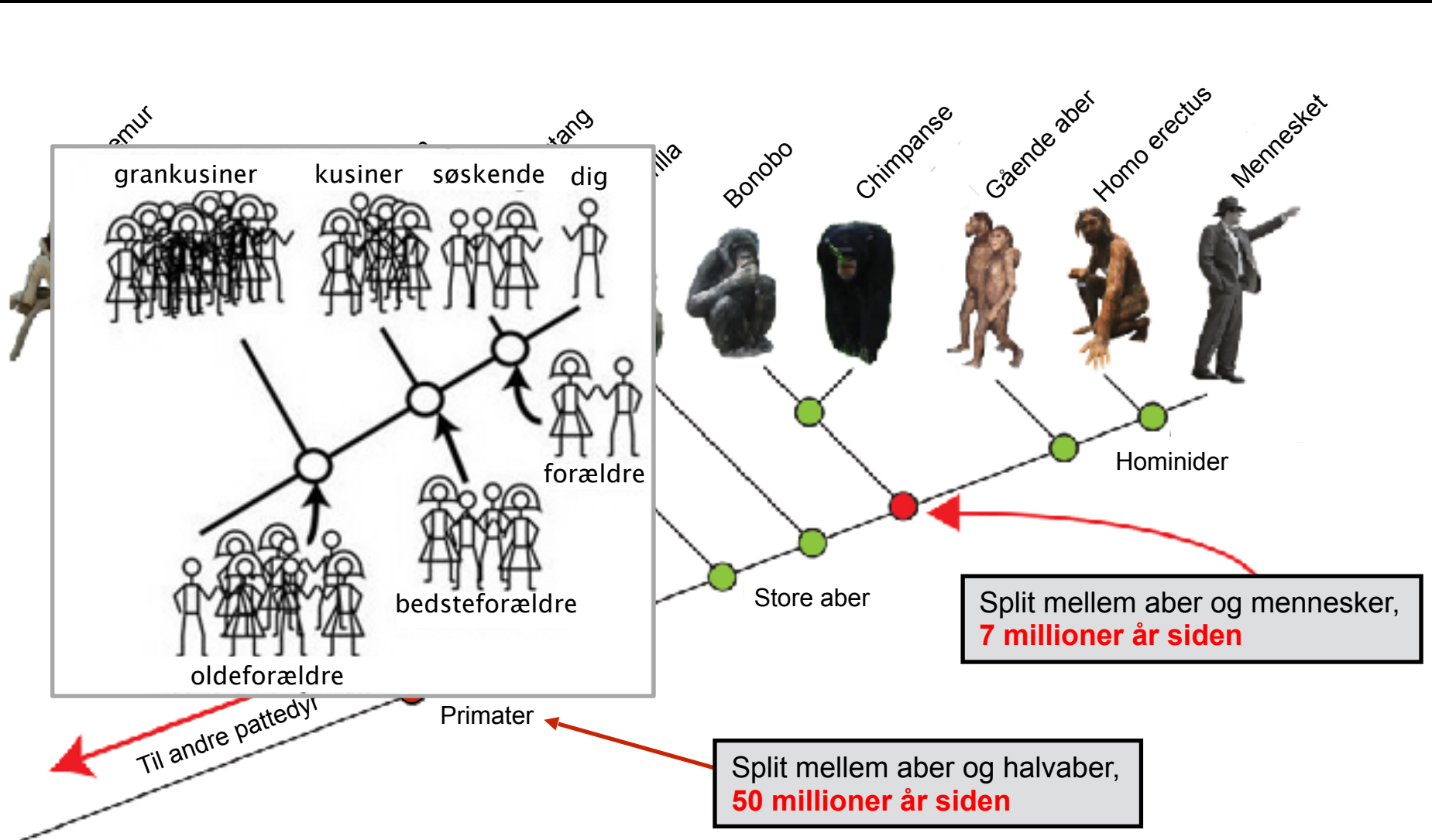
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# Vores familietræ

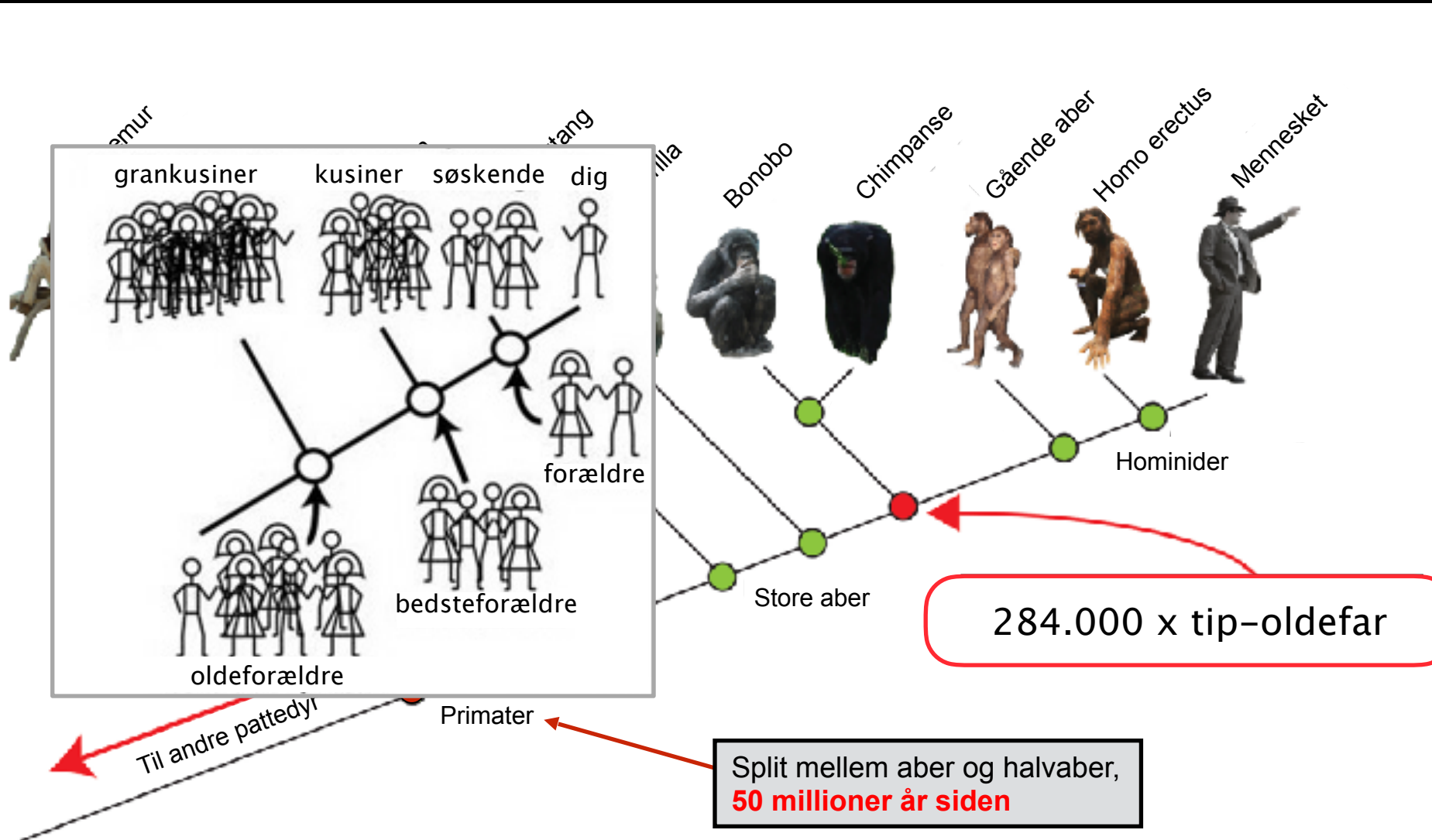




# Vores familietræ

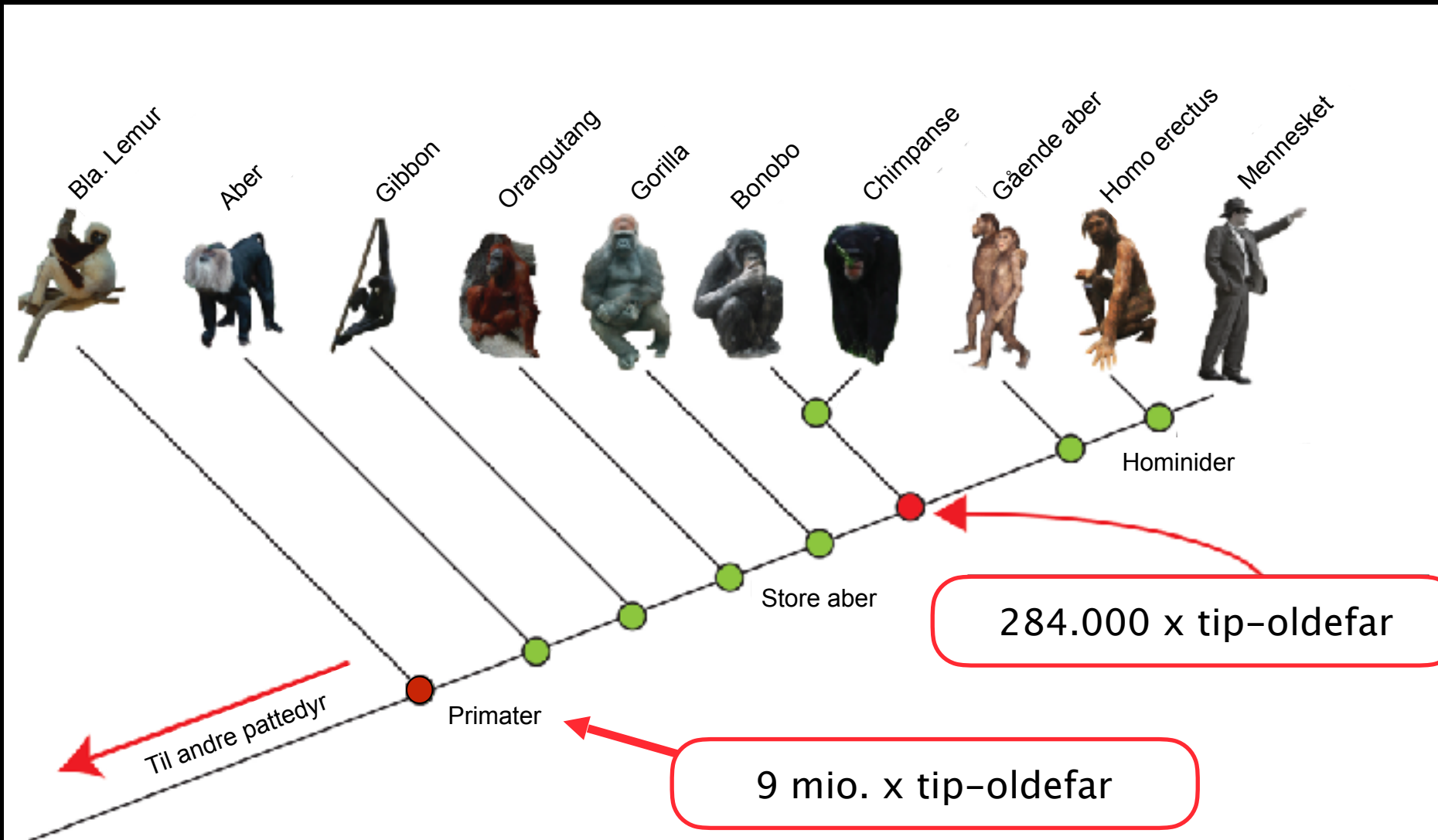


# Vores familietræ

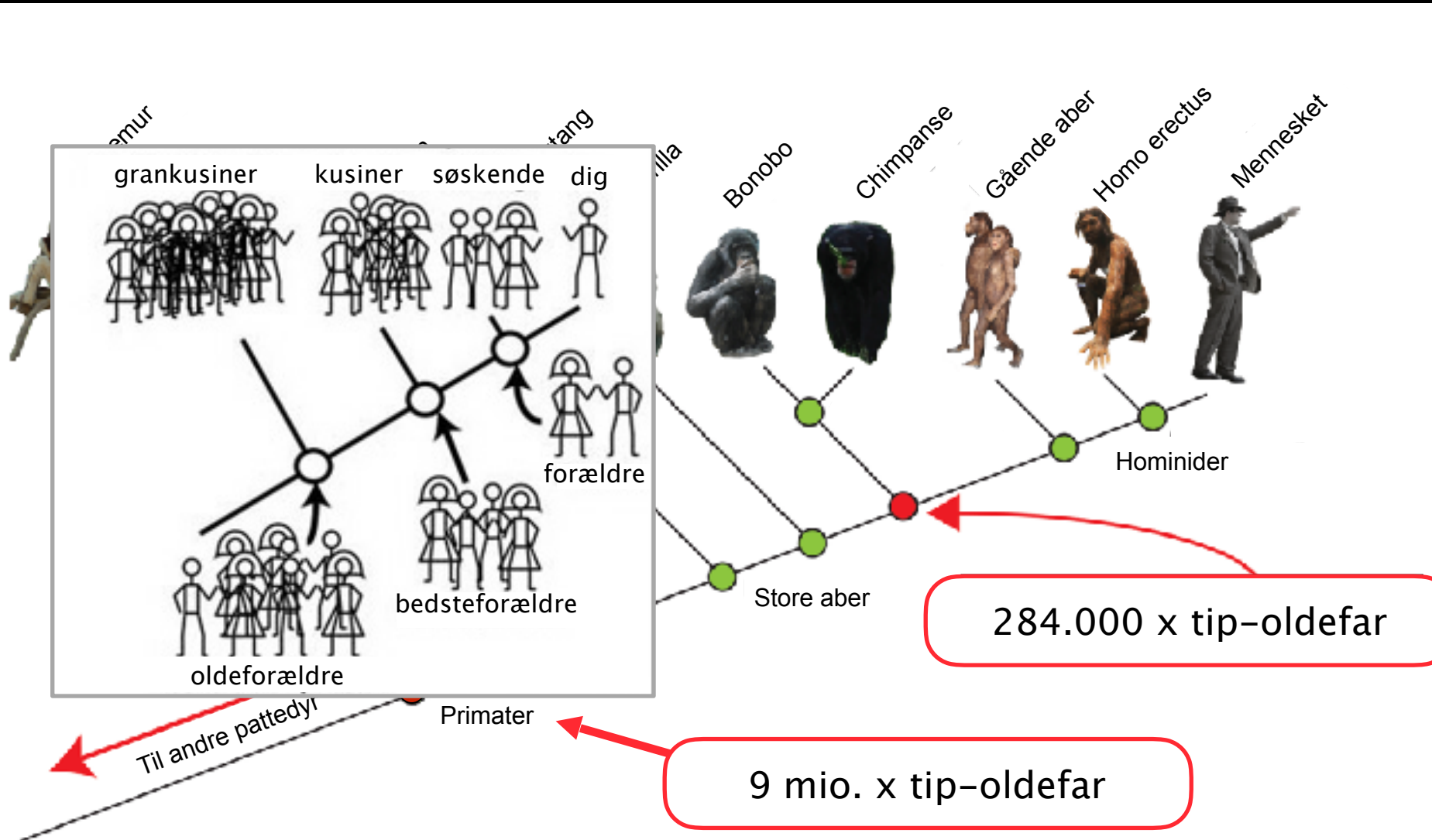




# Vores familietræ

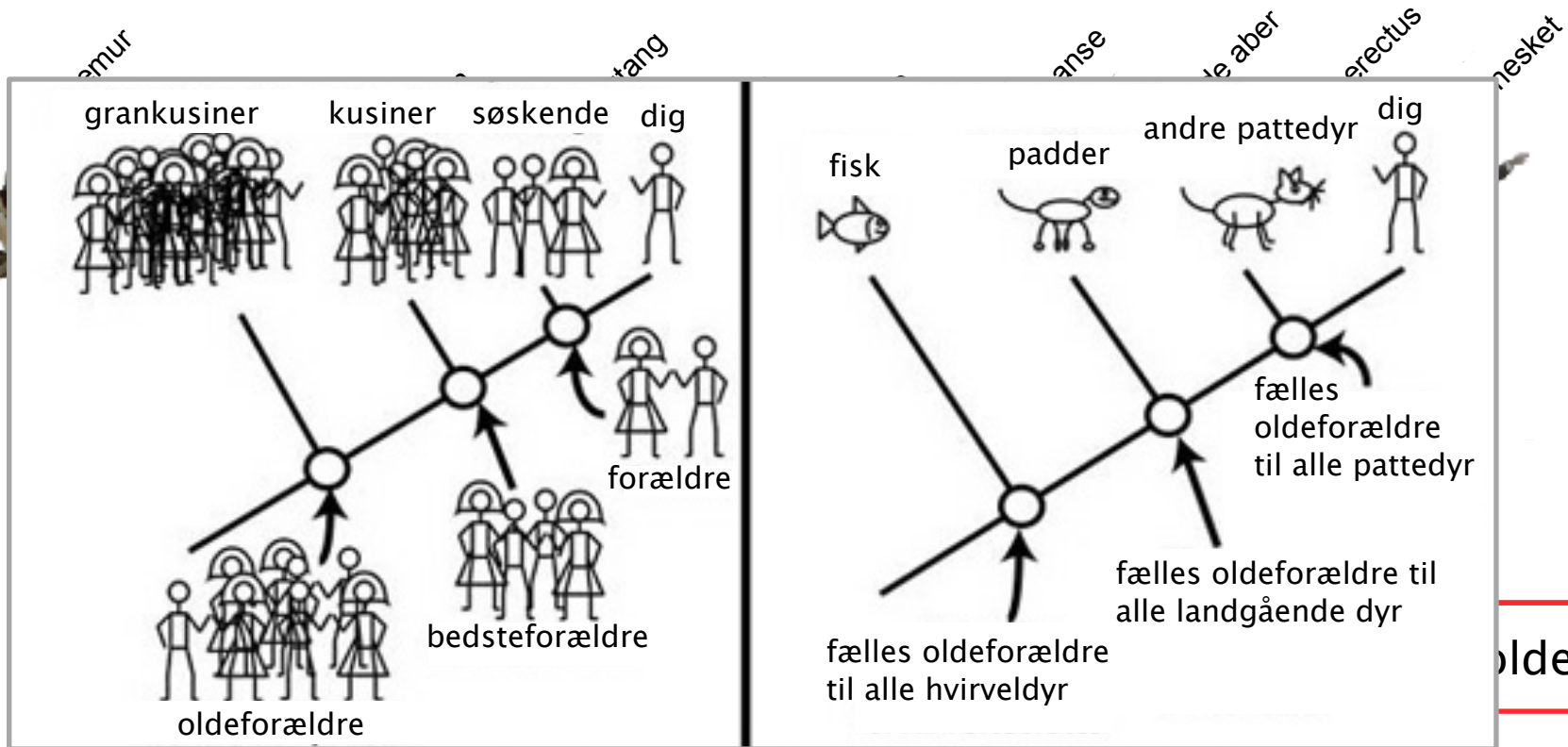


# Vores familietræ





# Vores familietræ

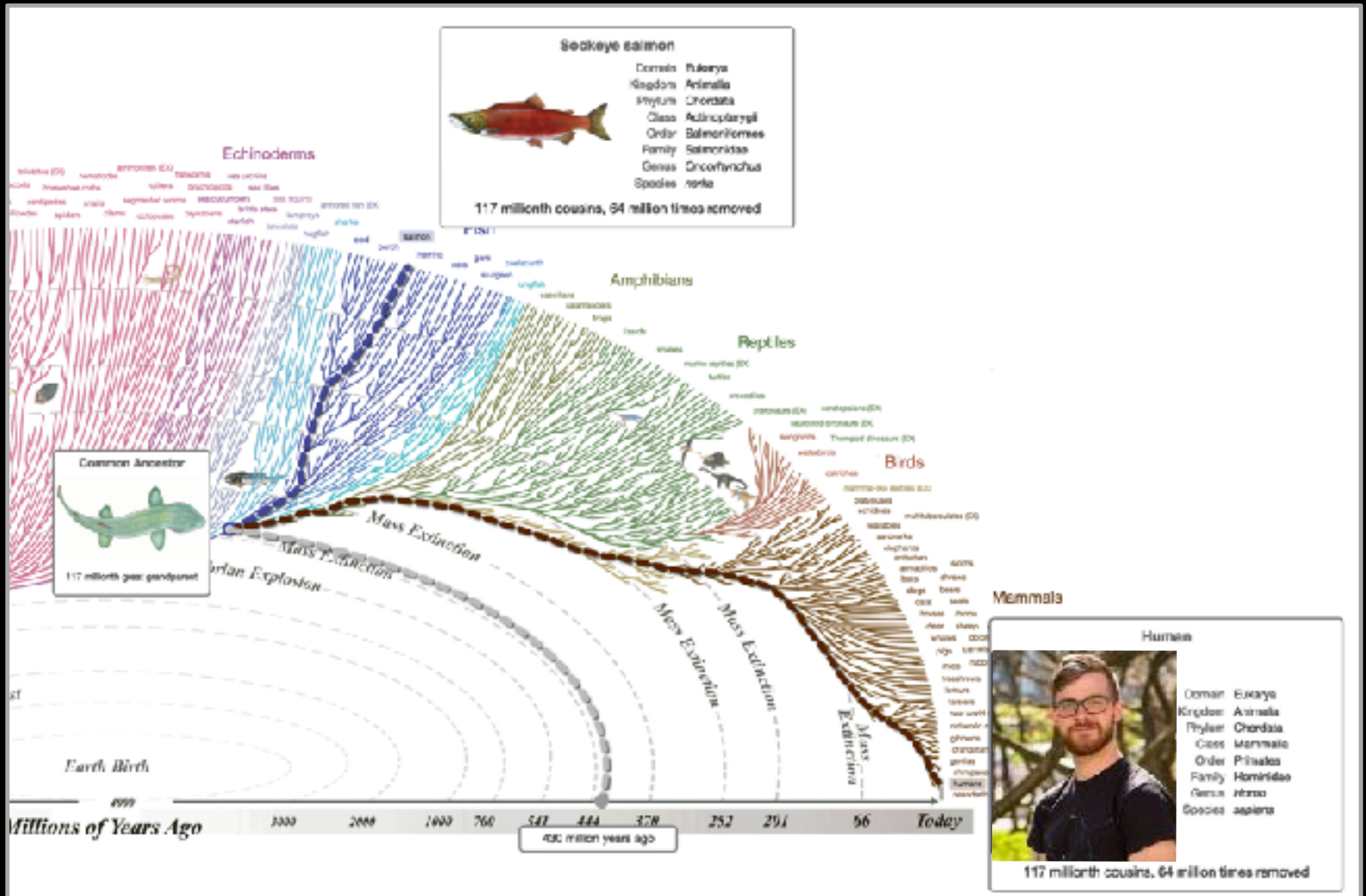


oldefar

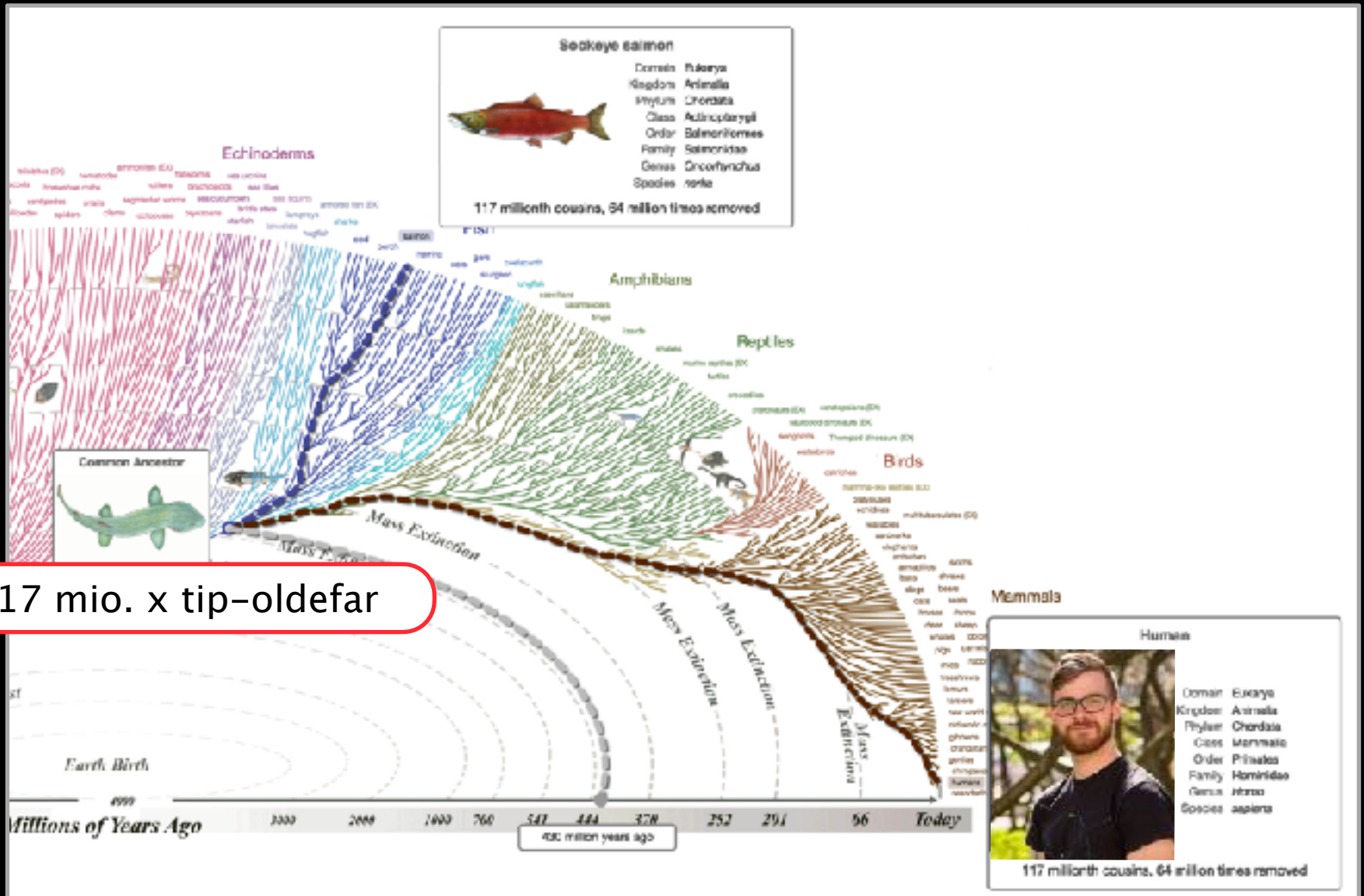
Til andre pattedyr  
Primater

9 mio. x tip-oldefar

# I familie med laksen?



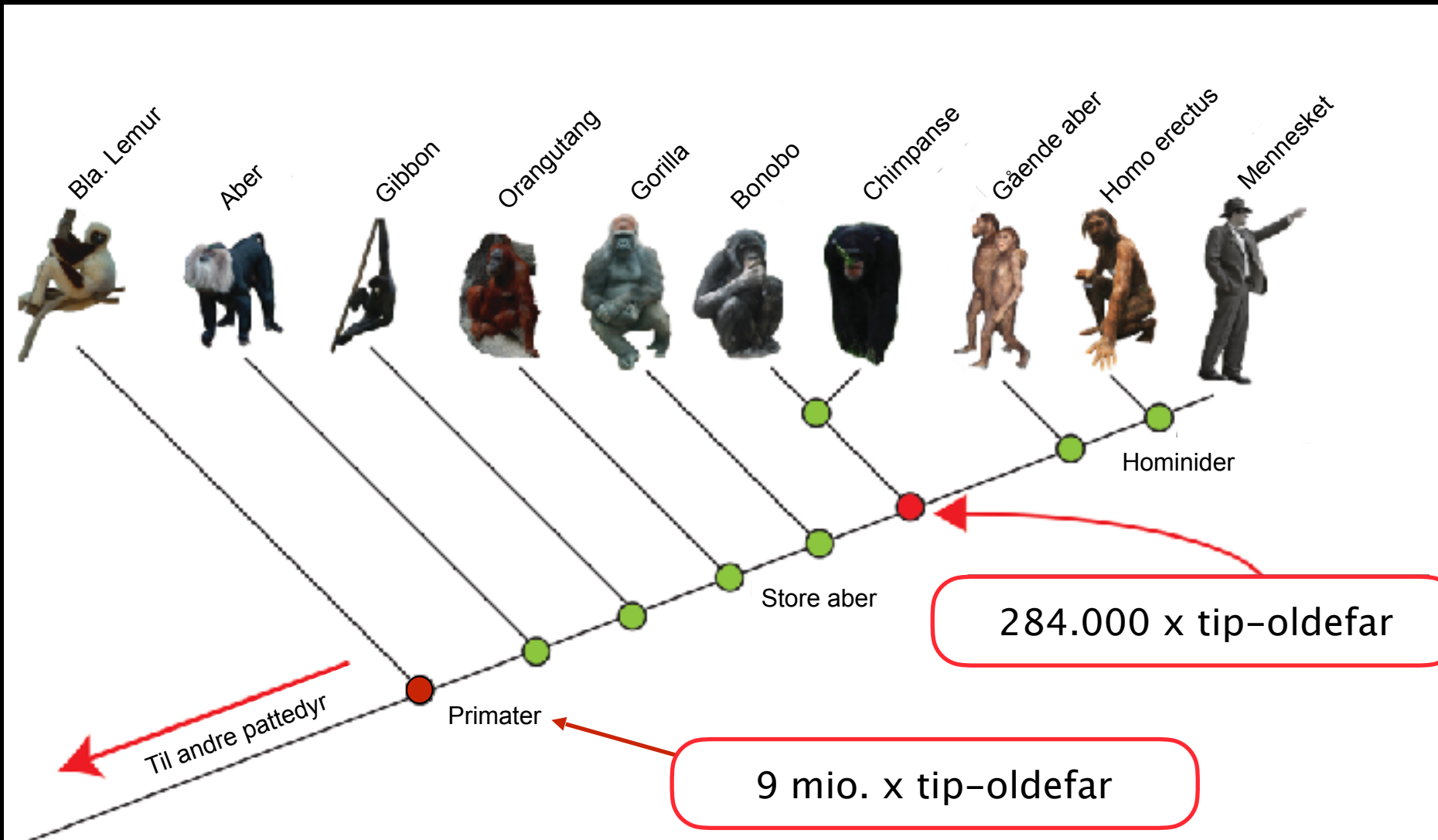
# I familie med laksen?



117 mio. x tip-oldefar

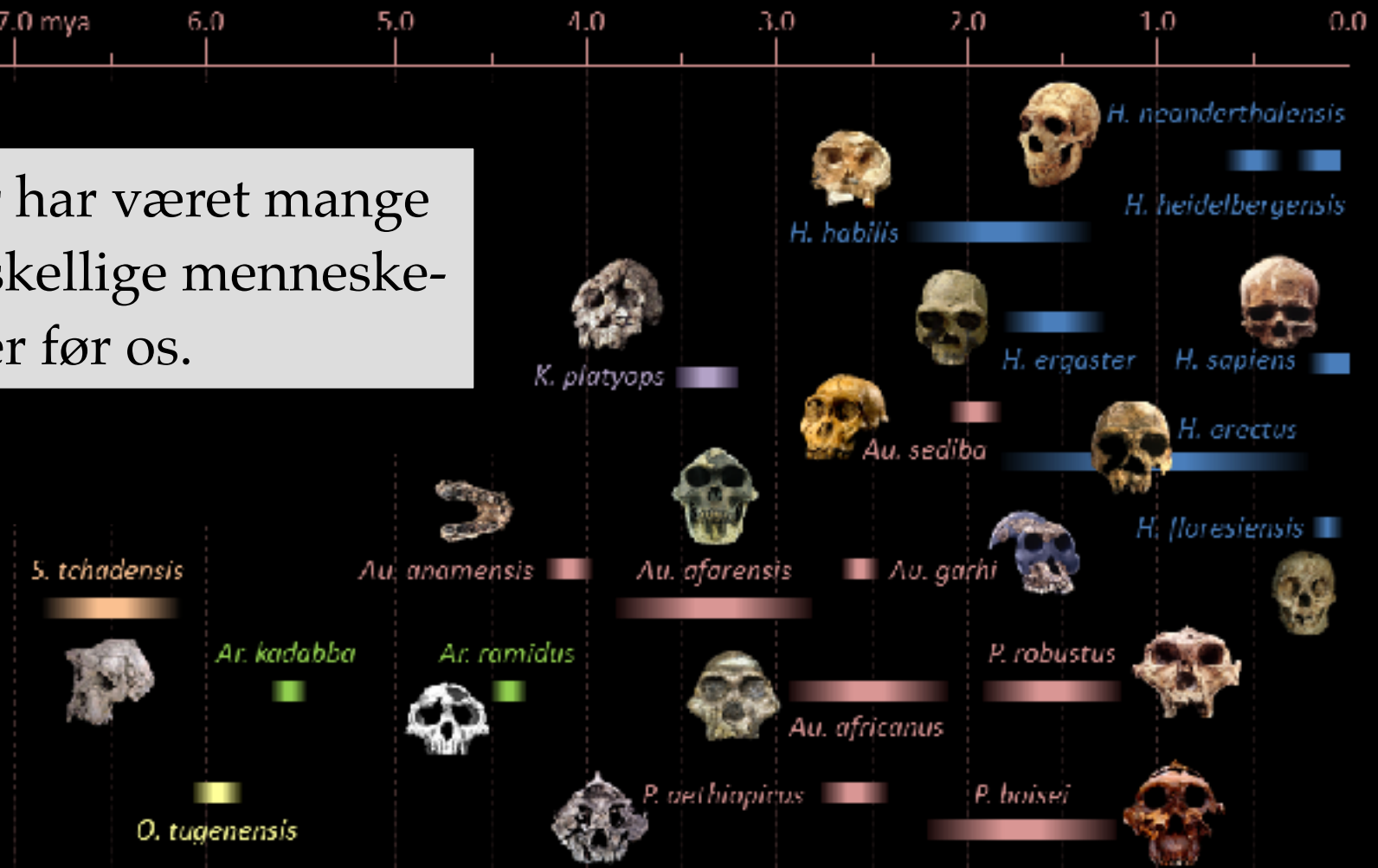


# Vores familietræ



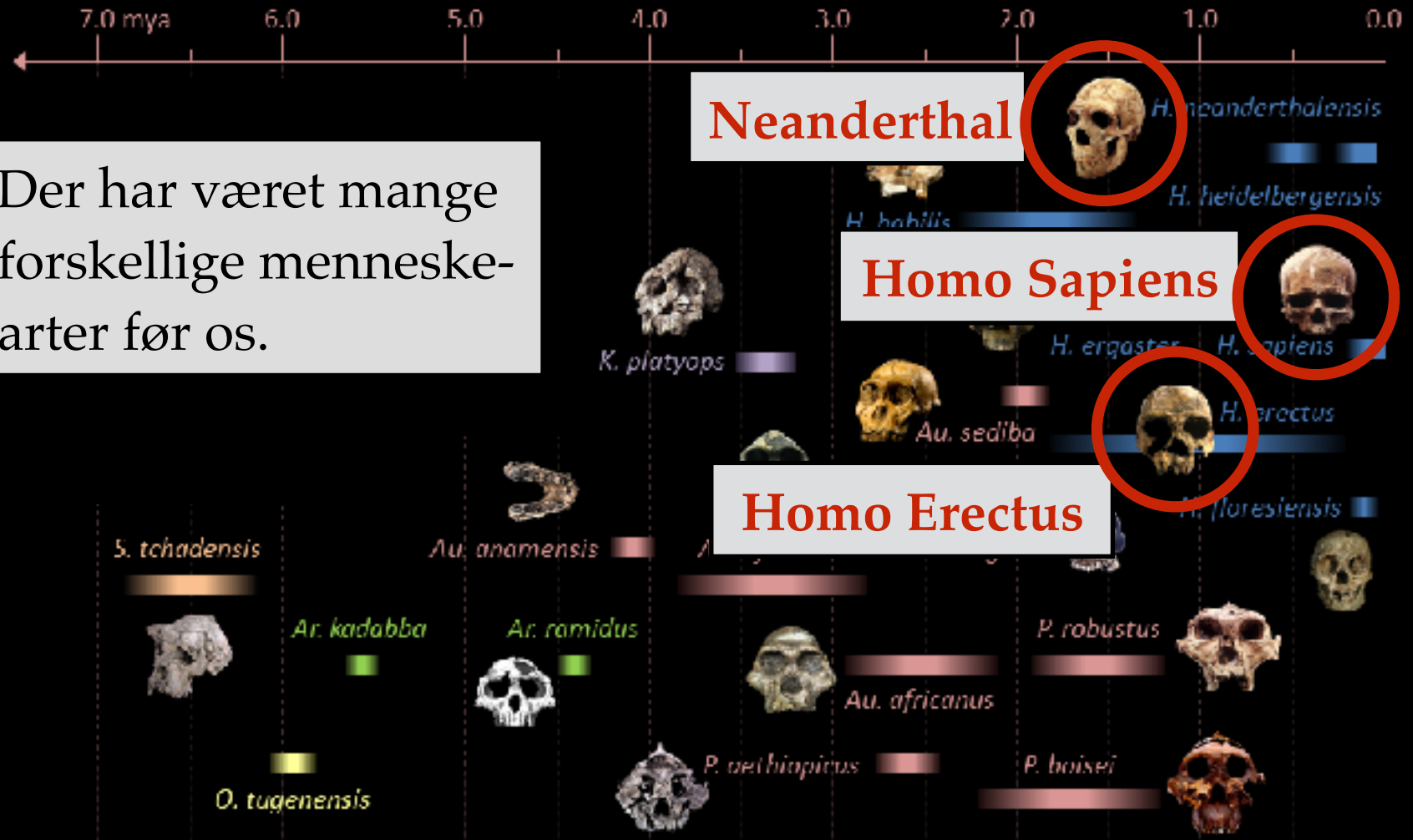
# De første hominider

Der har været mange forskellige menneskearter før os.



# De første hominider

Der har været mange forskellige menneskearter før os.



Neanderthal

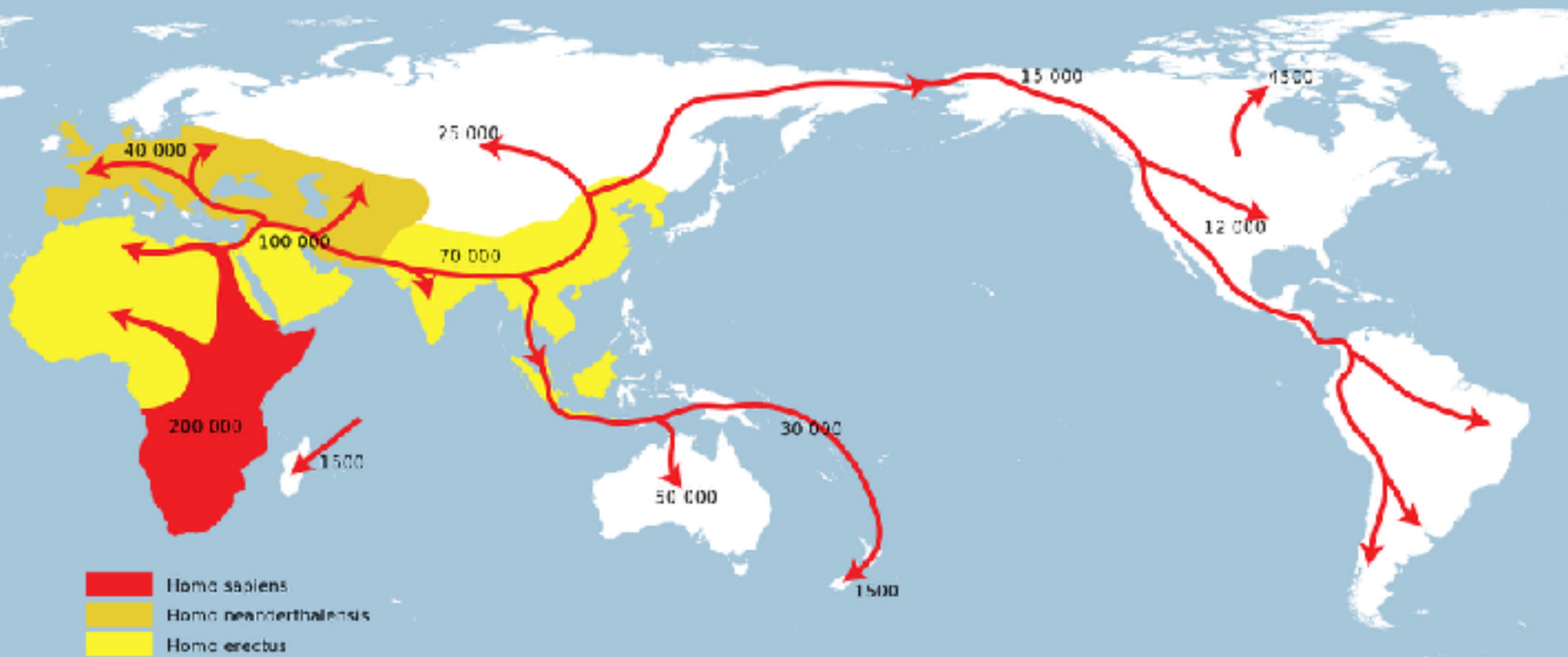
Homo Sapiens

Homo Erectus



# Moderne menneskes udbredelse

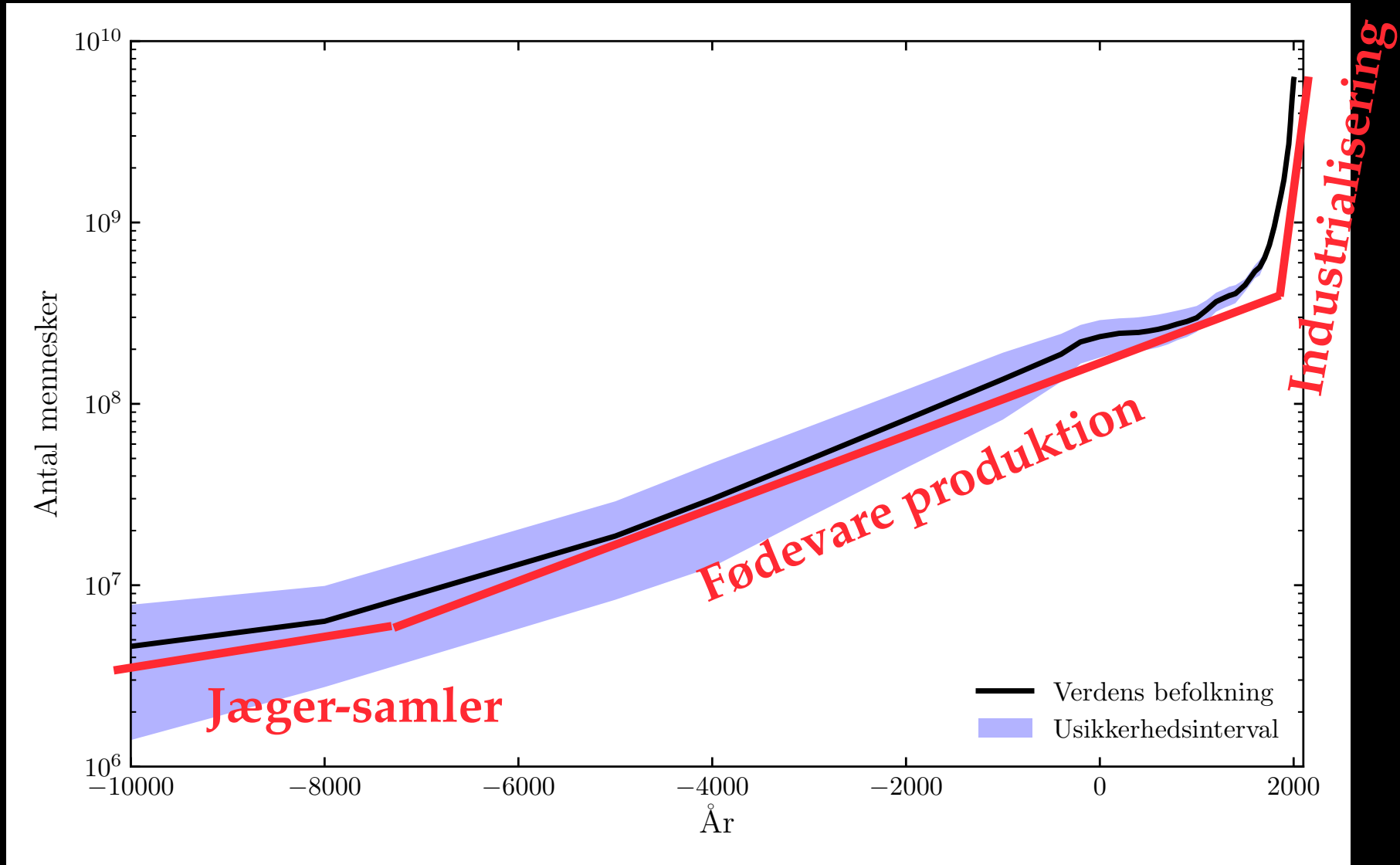
200.000 år siden



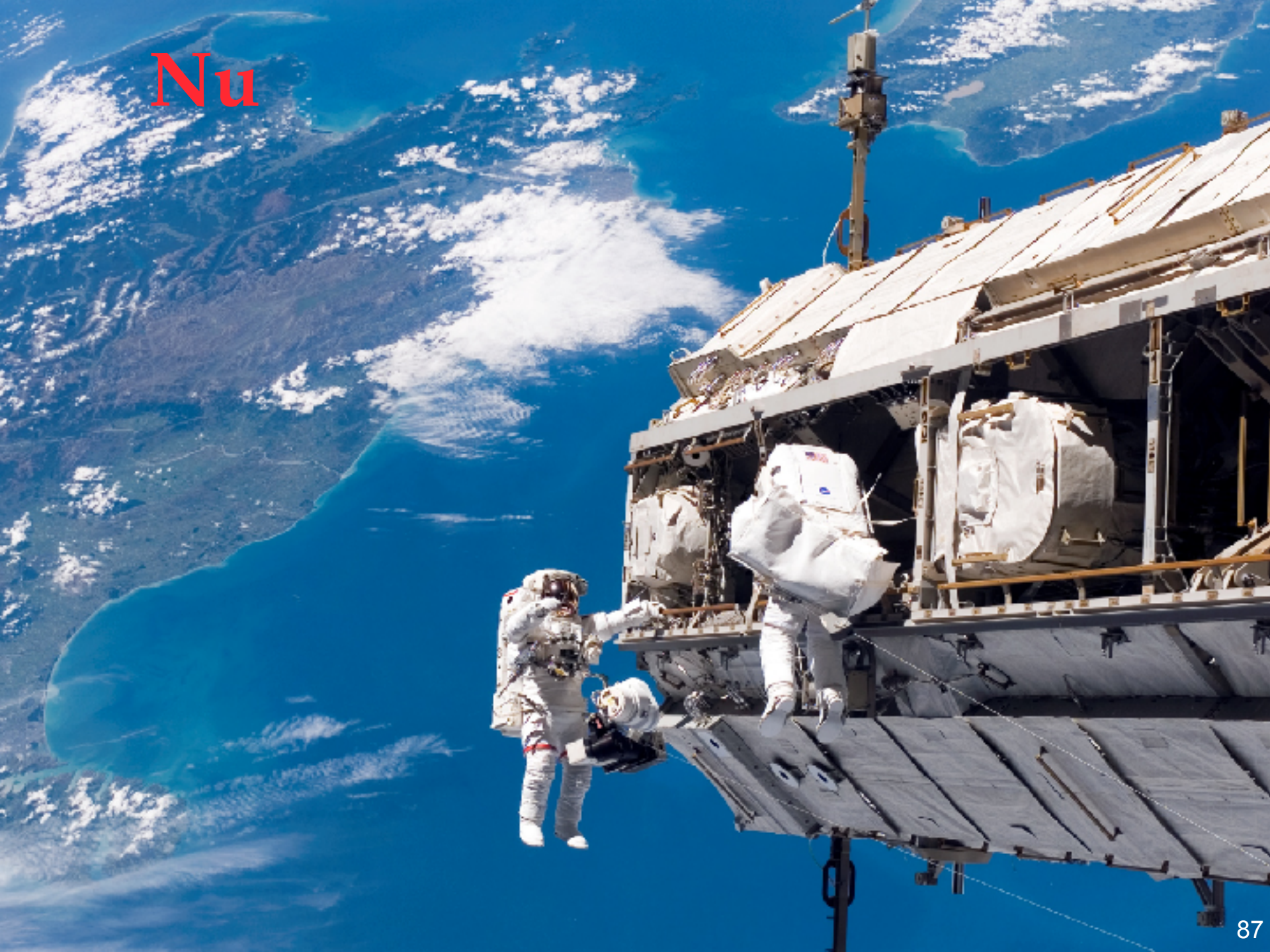
Note: Ovenstående kort er kun en tilnærmelse, og udvikles meget disse år!

# Jordens befolkning

og vores samfundsform & opfindelsers indflydelse!



Nu





# Mennesket er nået langt

(på geologisk set enormt kort tid)



