



FRA
BIG BANG
TIL
MODERNE MENNESKE

Skabelsesberetninger...



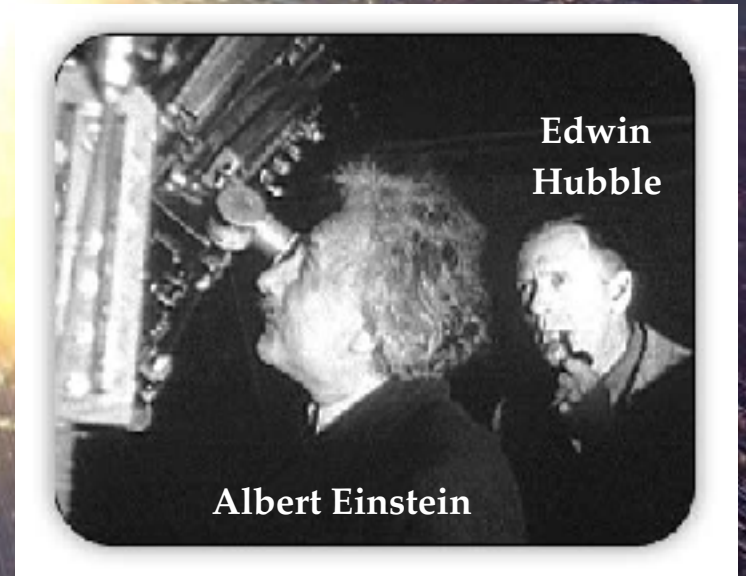
Tidlig forestilling om vores verden



13.8 milliarder år siden...

Big Bang

Hubbles opdagelse (1929)



Edwin
Hubble

Albert Einstein

Hubbles opdagelse (1929)

Velocity-Distance Relation among Extra-Galactic Nebulae.

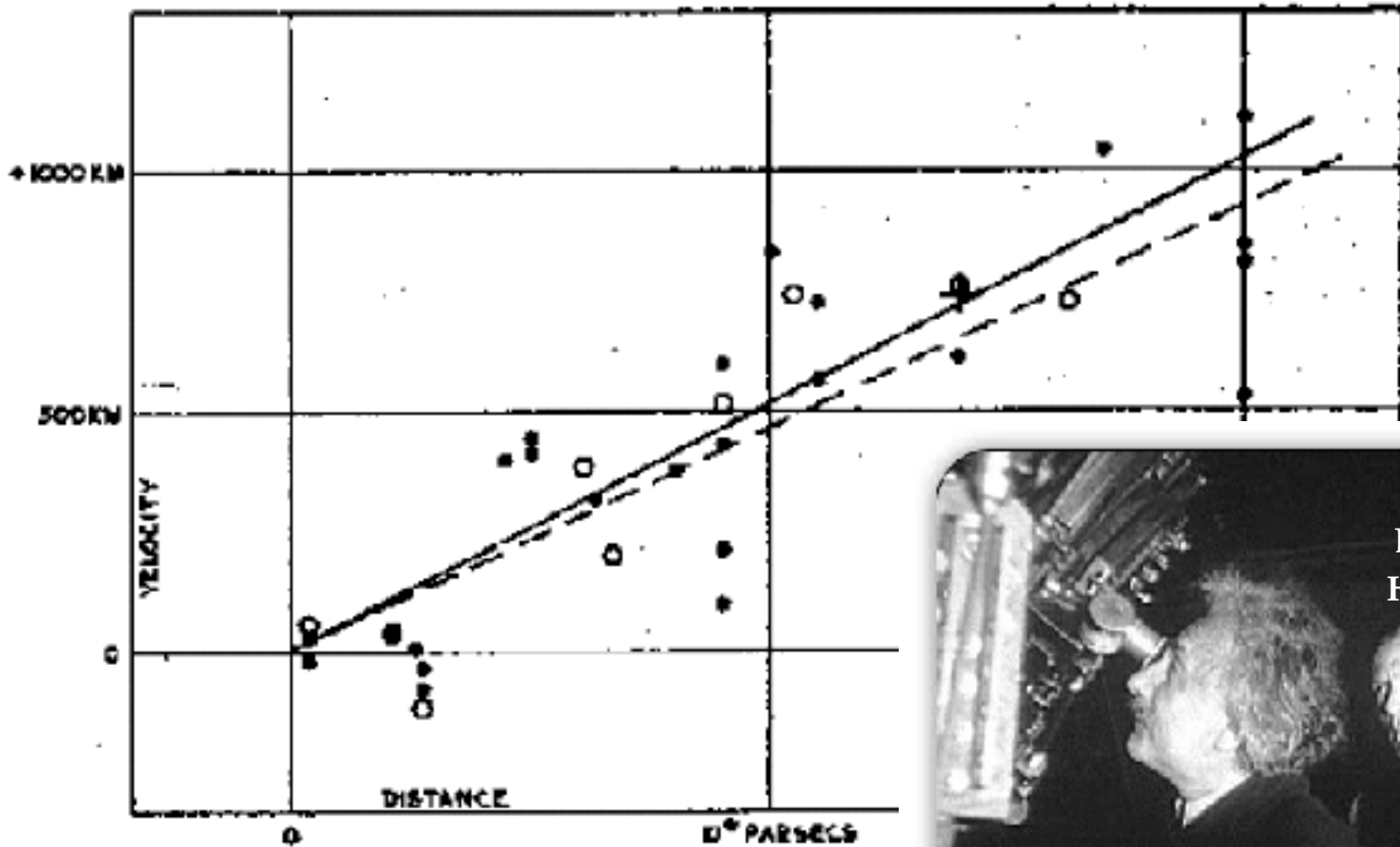
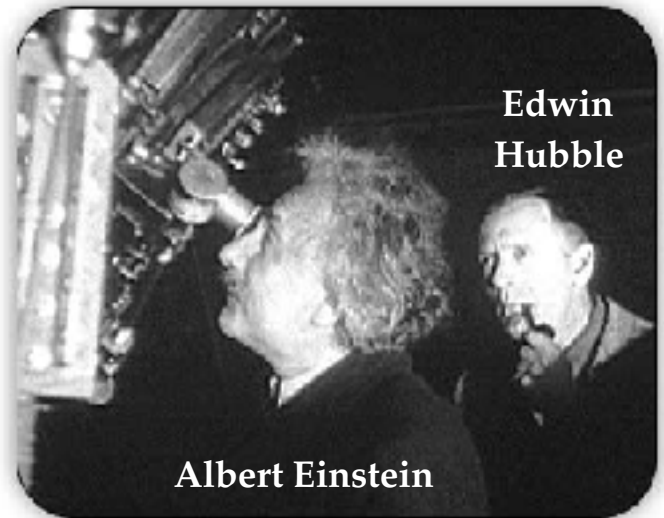


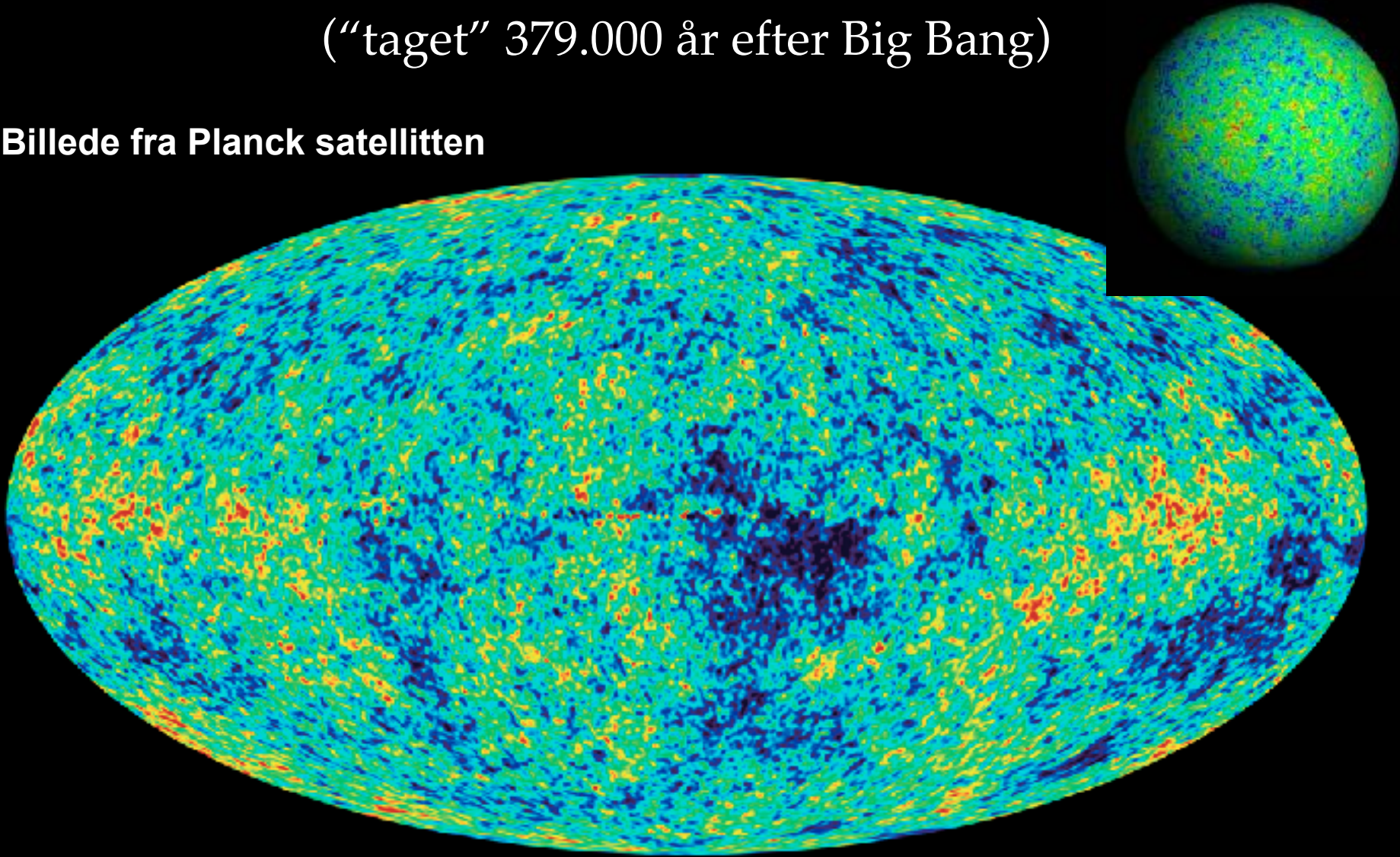
FIGURE 1



Første billede af Universet

(“taget” 379.000 år efter Big Bang)

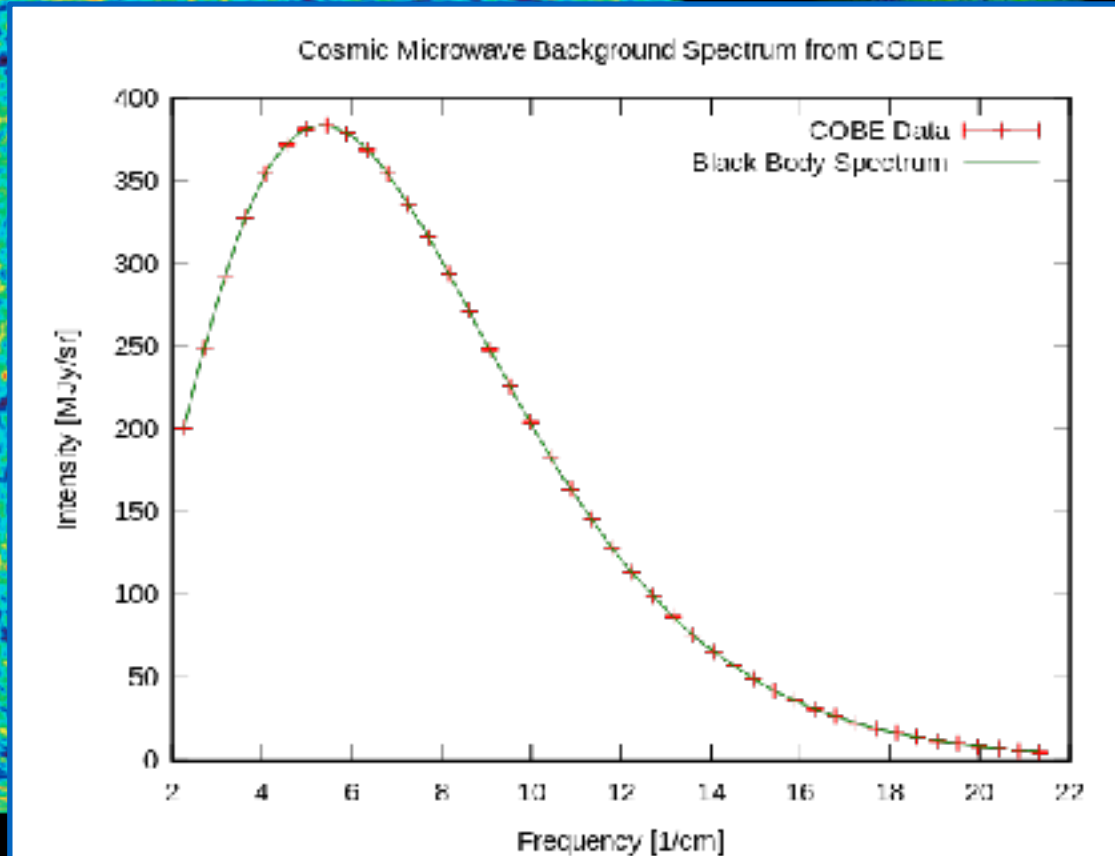
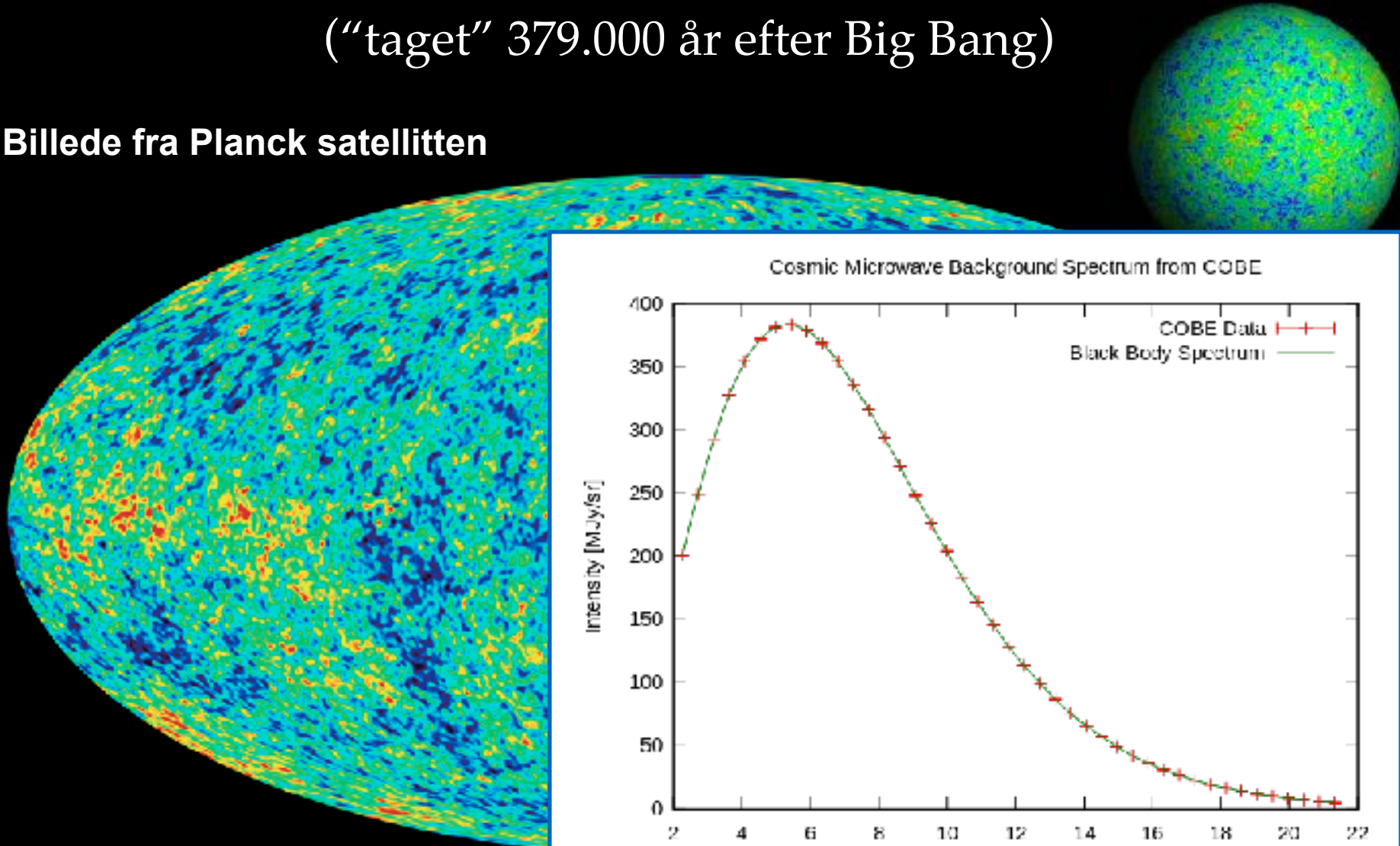
Billede fra Planck satellitten



Første billede af Universet

("taget" 379.000 år efter Big Bang)

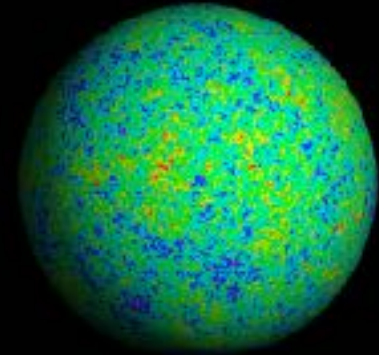
Billede fra Planck satellitten



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.

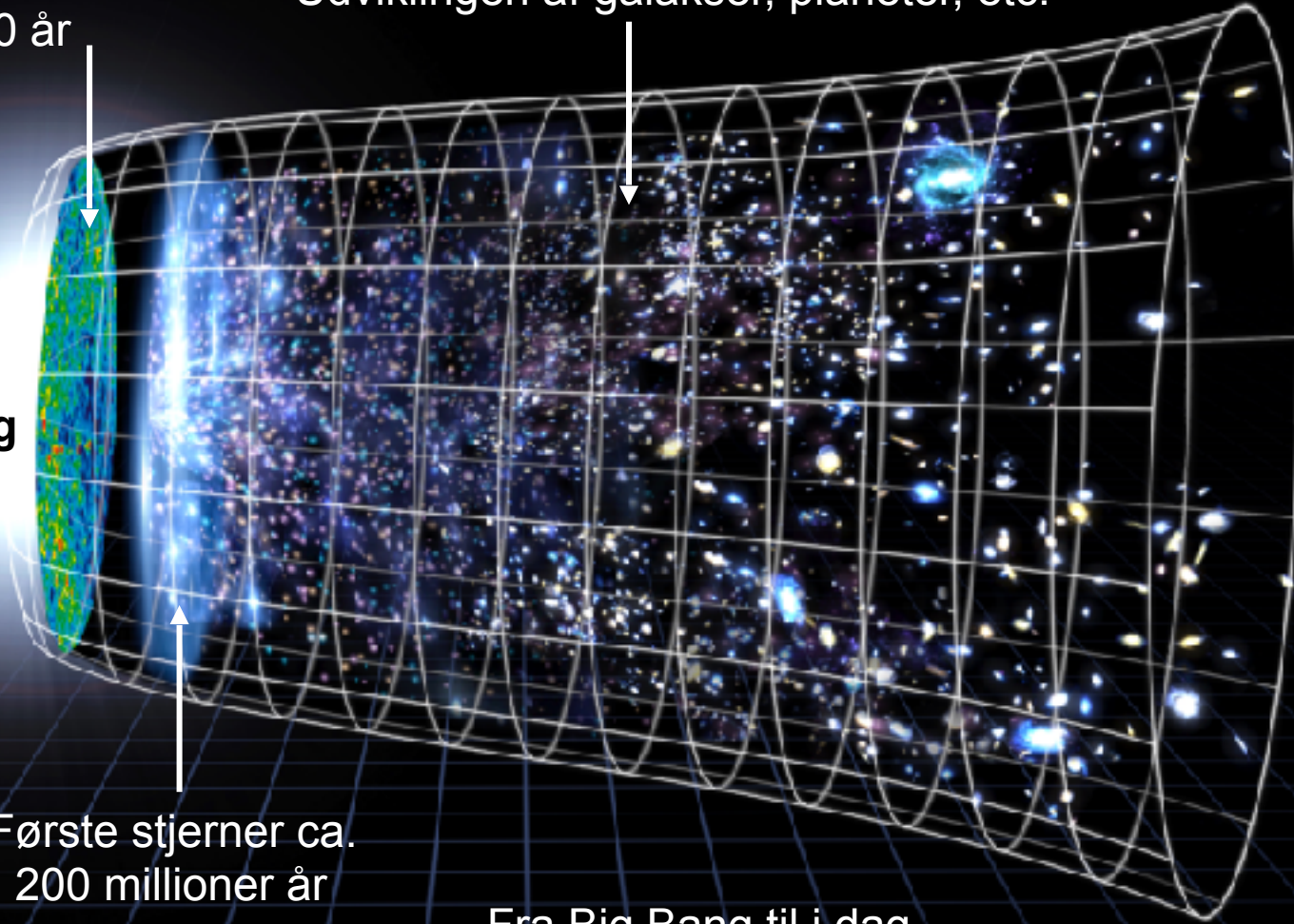
Big Bang

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:

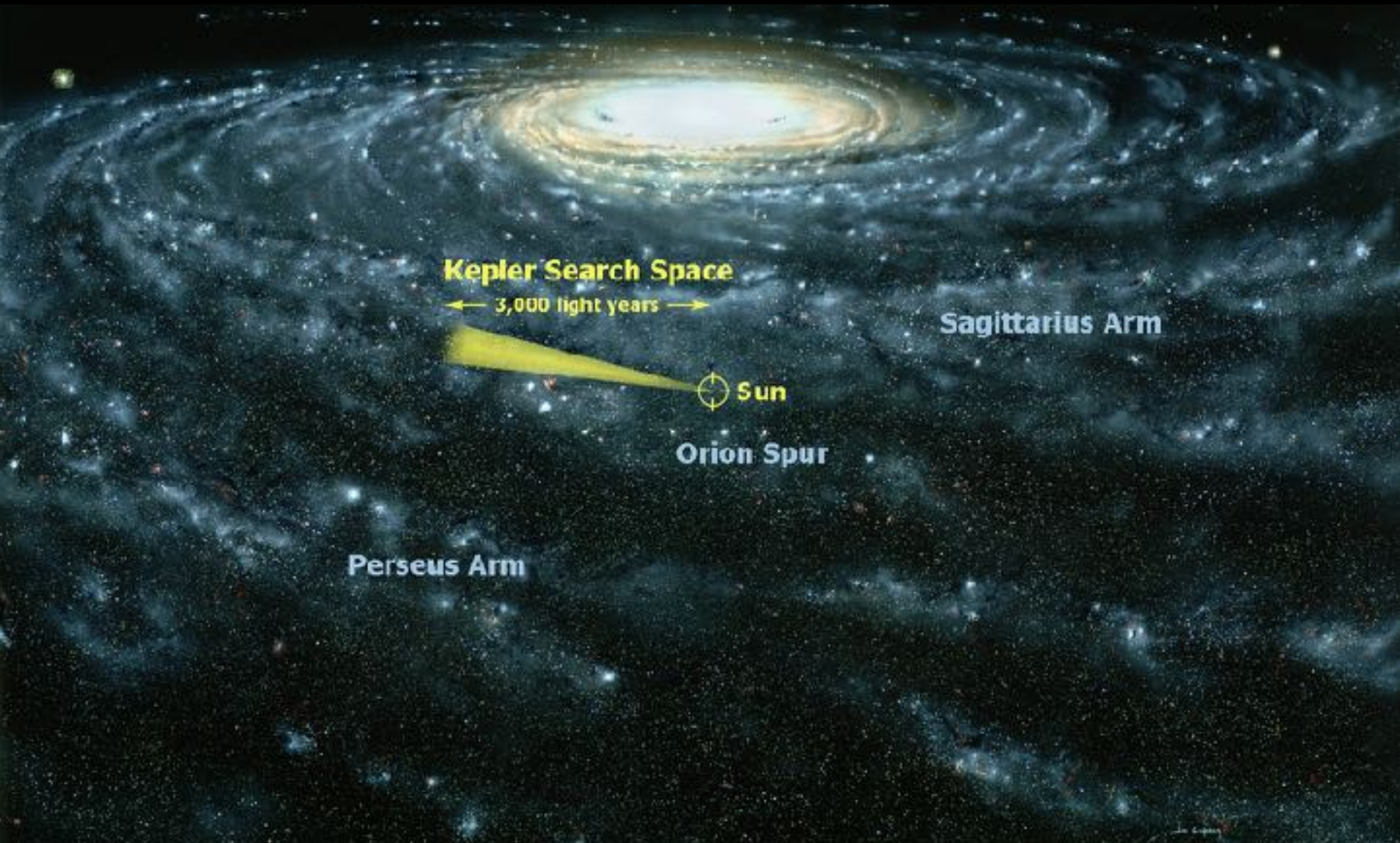
~ 300.000.000.000

Antal stjerner i en typisk galakse:

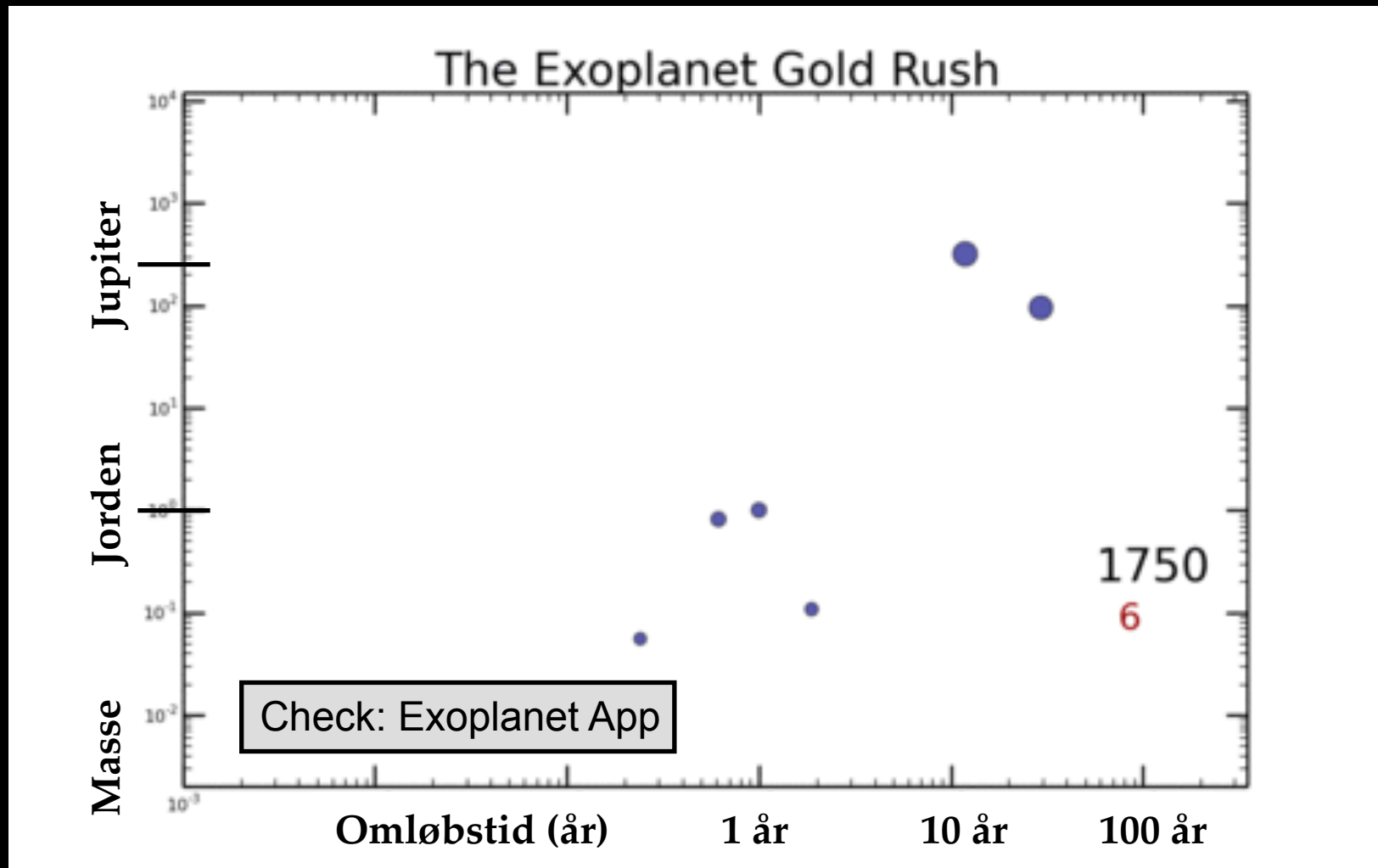
~ 300.000.000.000

Antal planeter om en typisk stjerne?

Planeter i Mælkevejen

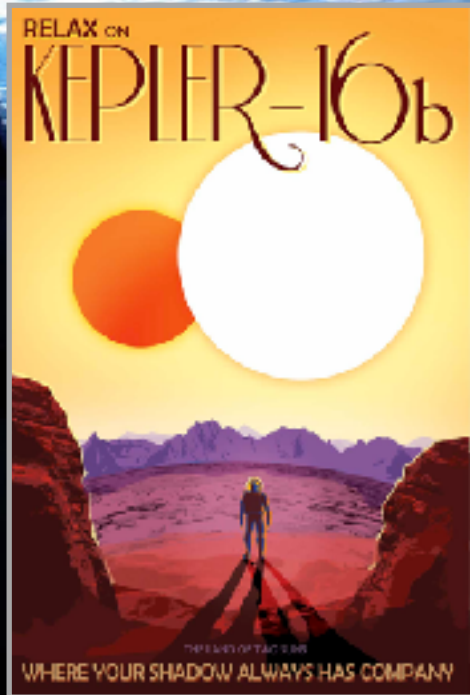


Opdagelsen af planeter



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

Potentielt beboelige planeter?



Den beboelige zone

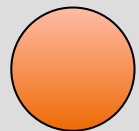


Den beboelige zone

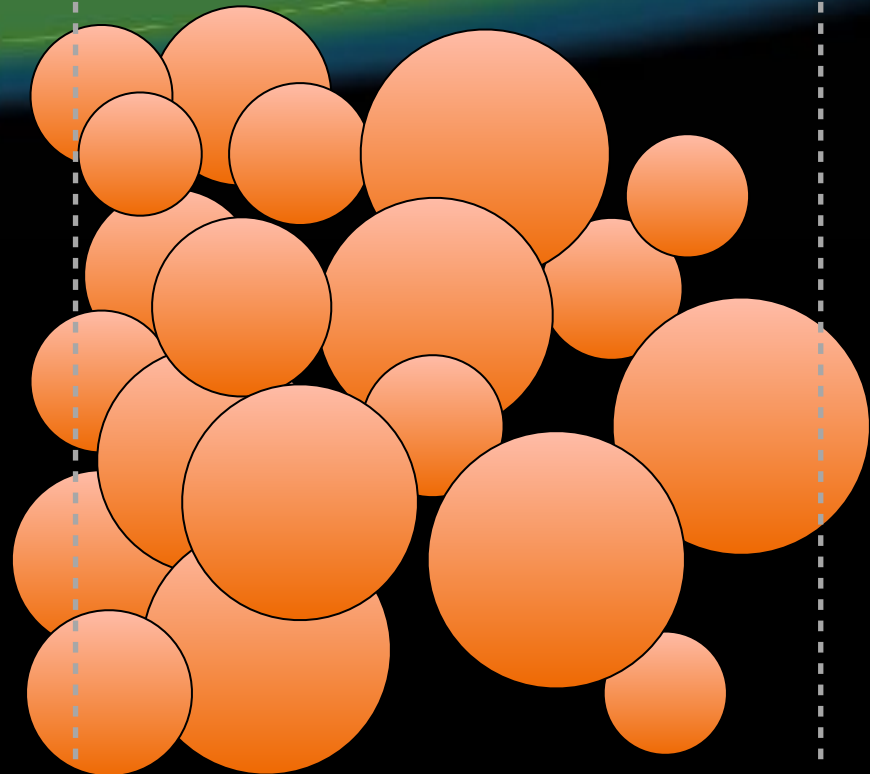
Indre solsystem



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

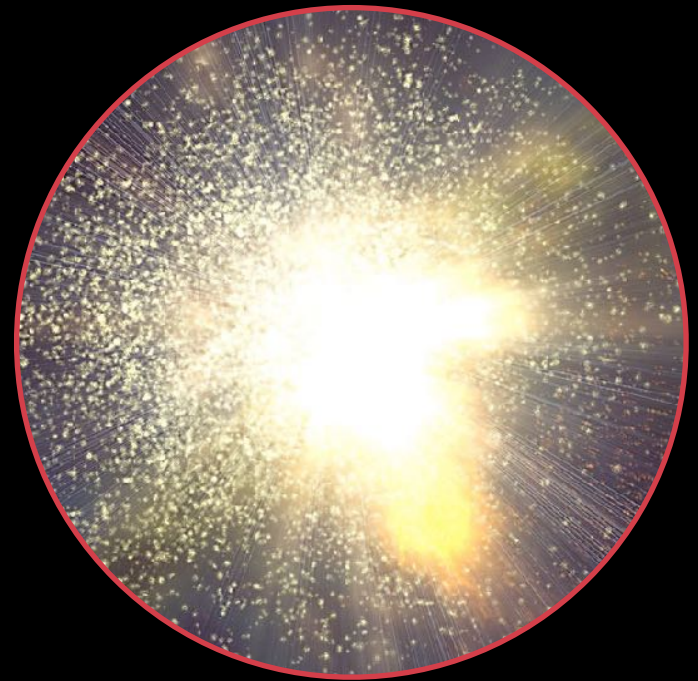
Med mulighed for liv: 0.1-1

Grundstoffernes oprindelse

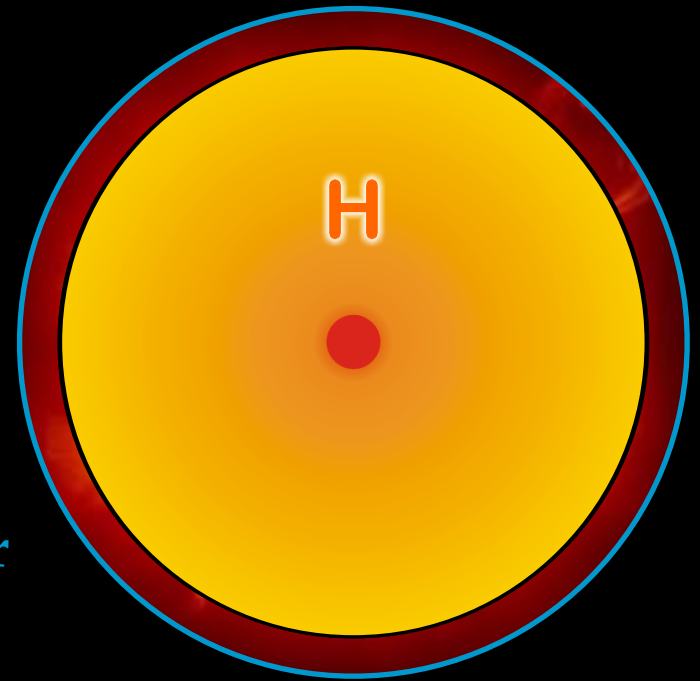
1
H

2
He

Big Bang



Grundstoffernes oprindelse



Big Bang

Tunge stjerner

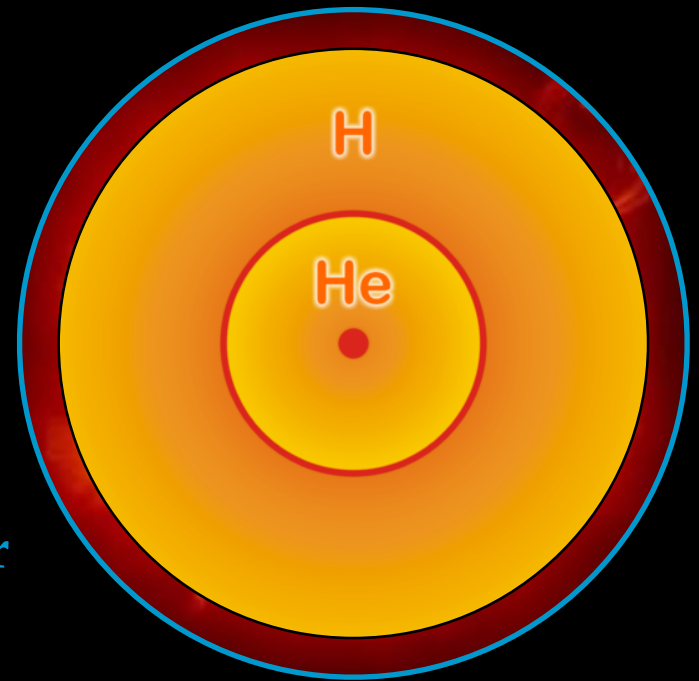
Grundstoffernes oprindelse

1
H

2
He

Big Bang

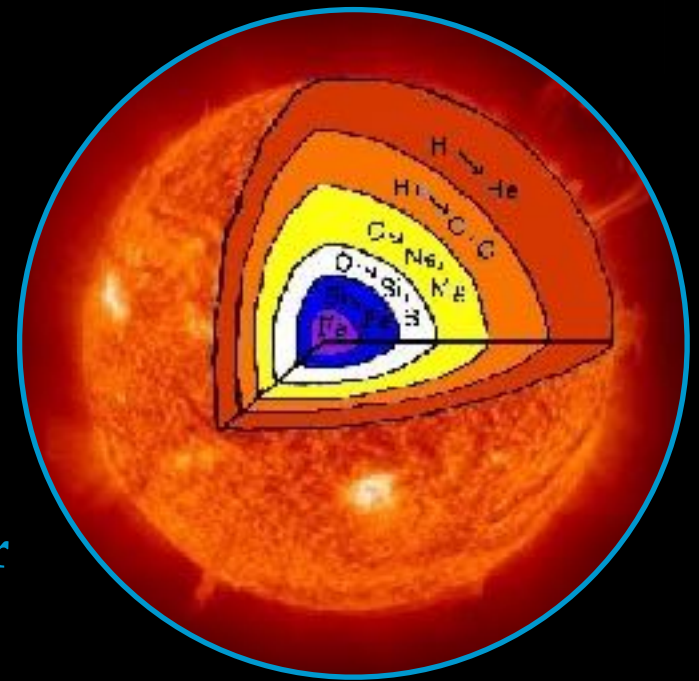
Tunge stjerner



Grundstoffernes oprindelse

1
H

2
He

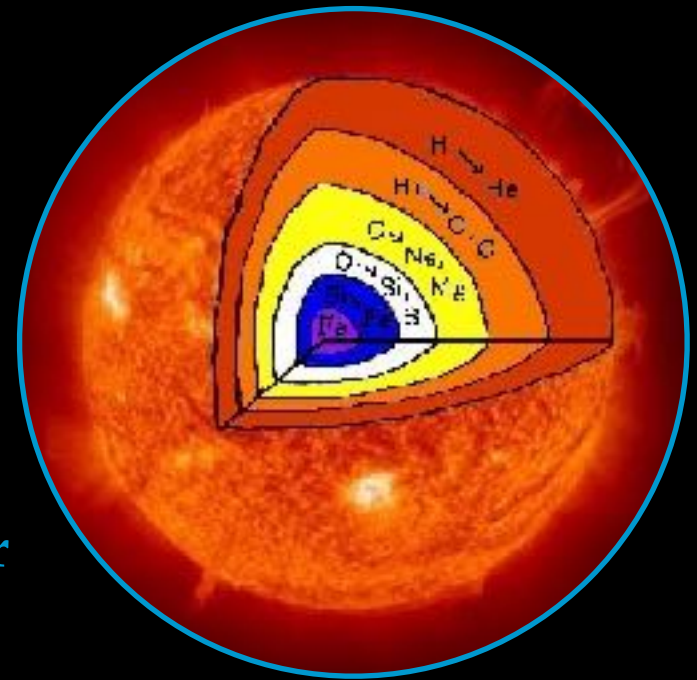


Big Bang

Tunge stjerner

Grundstoffernes oprindelse

1 H									2 He			
3 Li							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
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe					



Big Bang

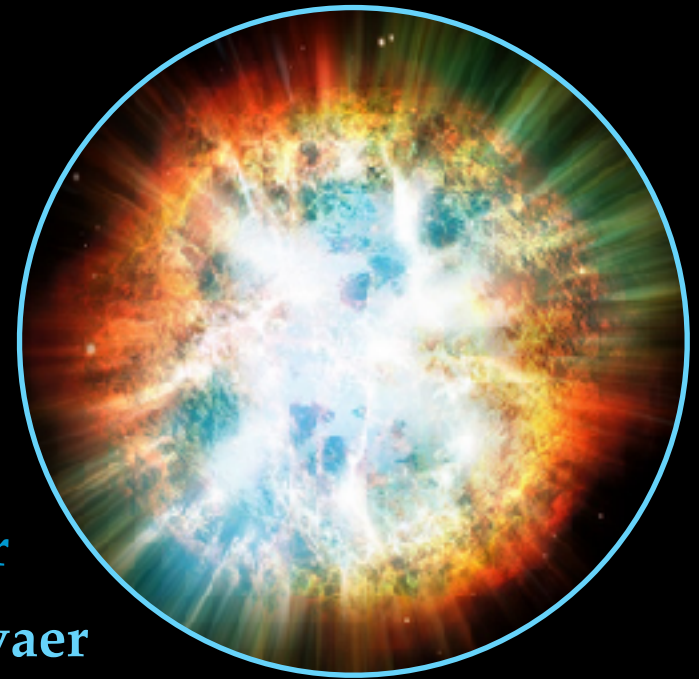
Tunge stjerner

Grundstoffernes oprindelse



Grundstoffernes oprindelse

1 H																	2 He
3 Li												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
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																	



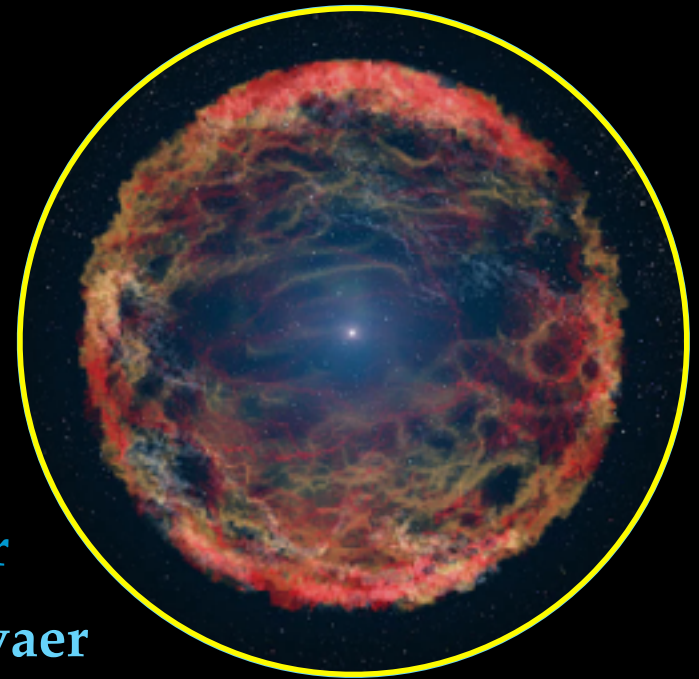
Big Bang

Tunge stjerner

Type 1a supernovaer

Grundstoffernes oprindelse

1 H																	2 He
3 Li												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
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

Grundstoffernes oprindelse

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11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
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

Neutron stjerner

Grundstoffernes oprindelse

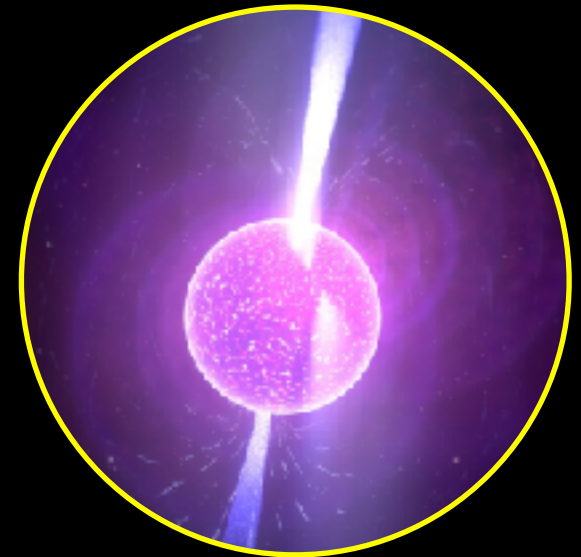


Type 1a supernovaer

Neutron stjerner

Grundstoffernes oprindelse

1 H																		2 He	
3 Li												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		
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

Neutron stjerner

Grundstoffernes oprindelse

1 H																	2 He									
3 Li											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									
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	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

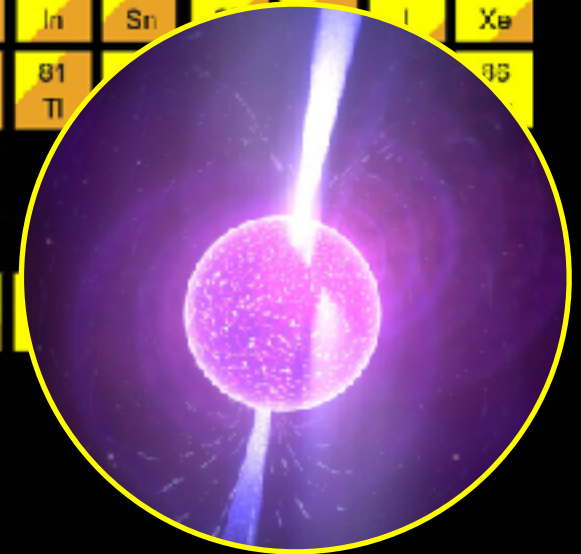
Tunge stjerner

Type 1a supernovaer

Neutron stjerner

Grundstoffernes oprindelse

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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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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	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
				89 Ac	90 Th	91 Pa	92 U											

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																			
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																			
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87 Fr	88 Ra																																			
																	89 Ac	90 Th	91 Pa	92 U						93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Big Bang

Tunge stjerner

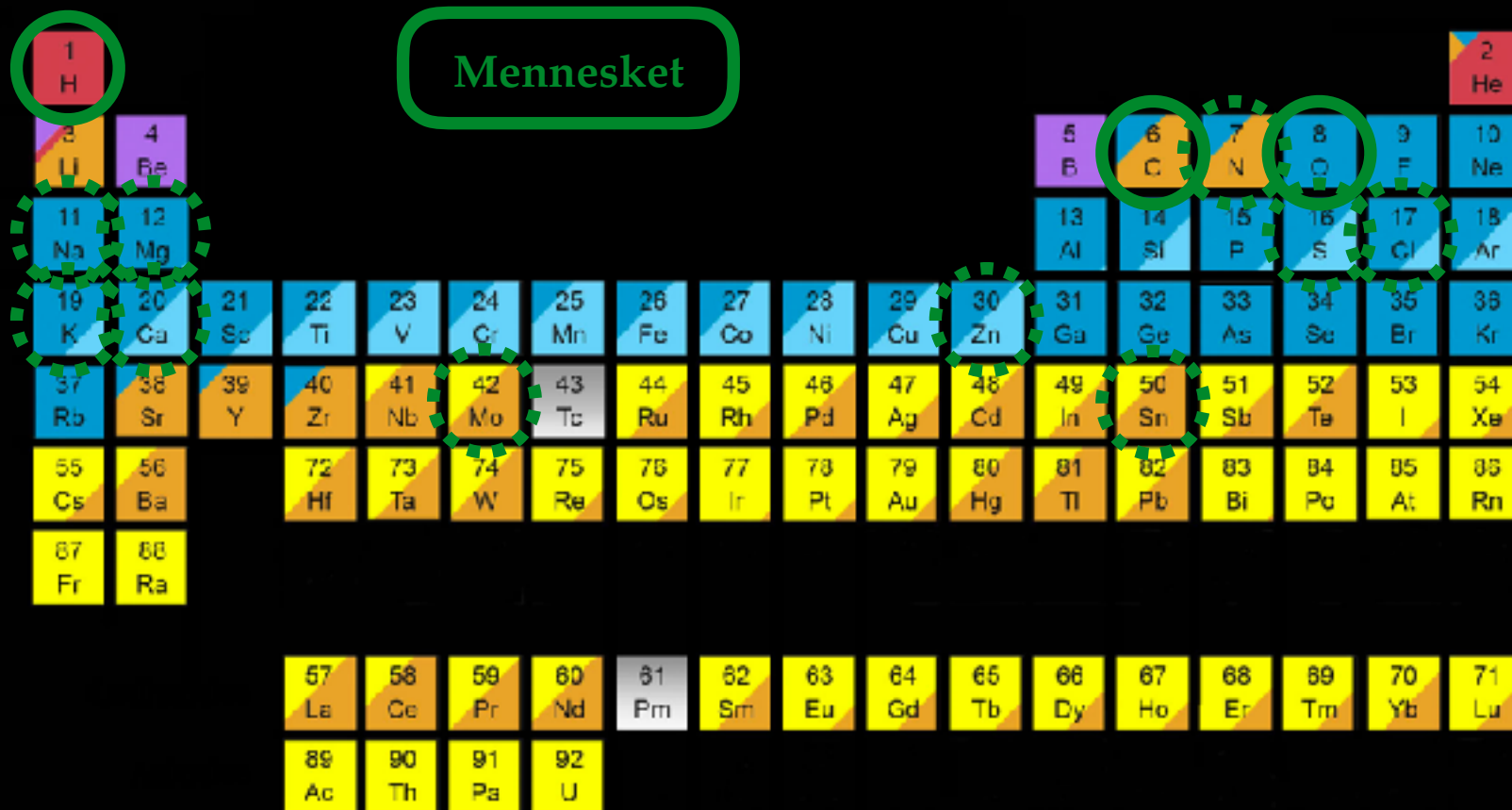
Rød kæmpe fase

Kosmiske stråler

Type 1a supernovaer

Neutron stjerner

Grundstoffernes oprindelse



Big Bang

Tunge stjerner

Rød kæmpe fase

Kosmiske stråler

Type 1a supernovaer

Neutron stjerner

Grundstoffer

lige efter Big Bang



Grundstoffer

i dag



▪
Mg

▪
C

▪
N

▪
O

▪
Ne

▪
Si

▪
S

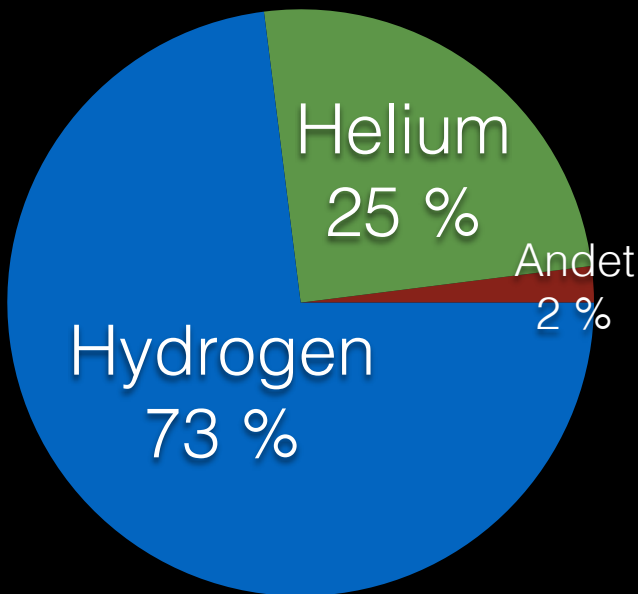
▪
Ar

▪
Fe

Grundstoffernes hyppighed

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

Universet

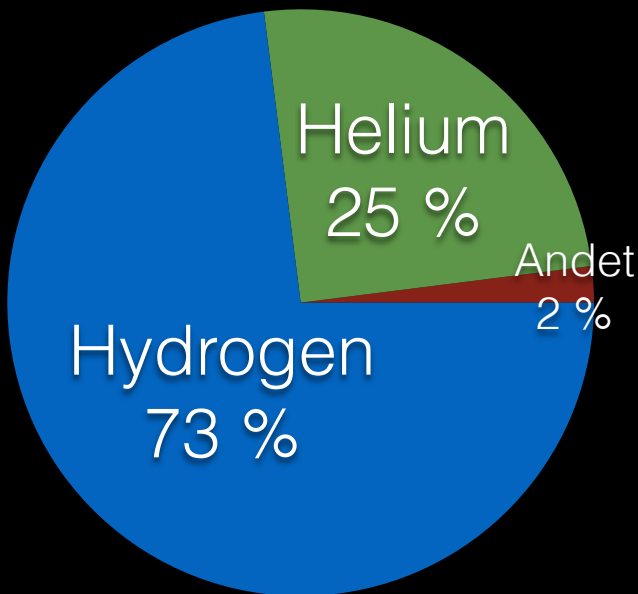


Forskellene kan forklares med af **mekanismerne** bag

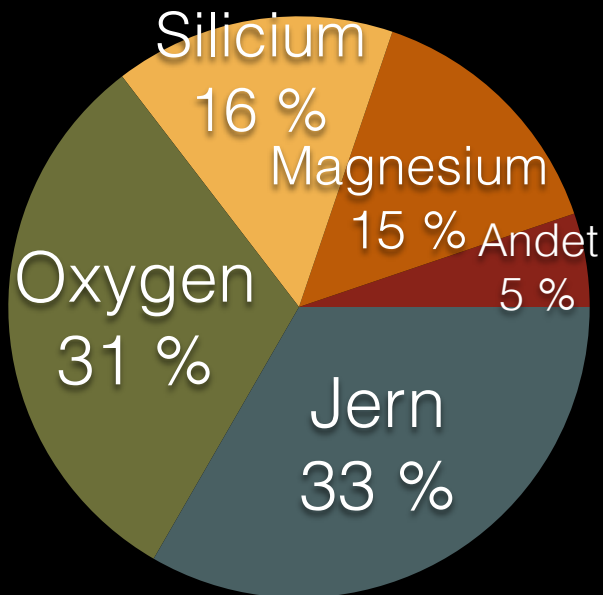
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Universet



Jorden

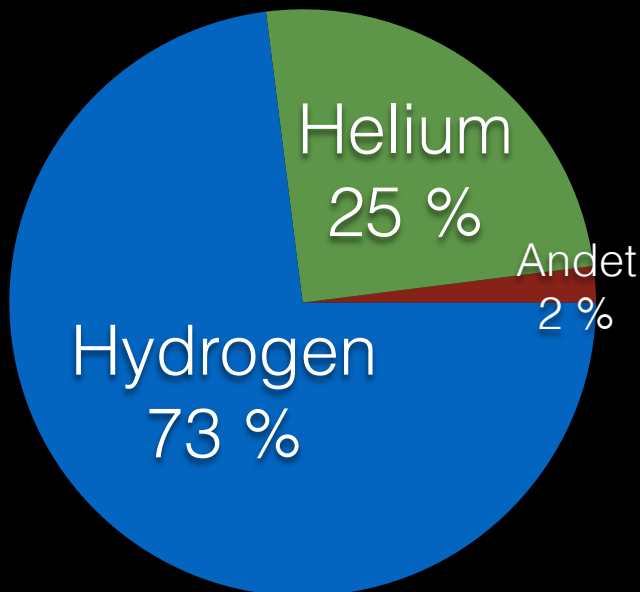


Forskellene kan forklares med af **mekanismerne** bag

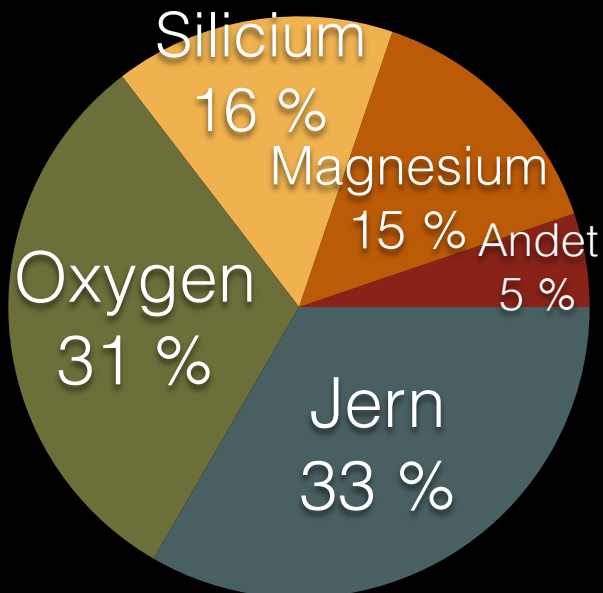
Grundstoffernes hyppighed

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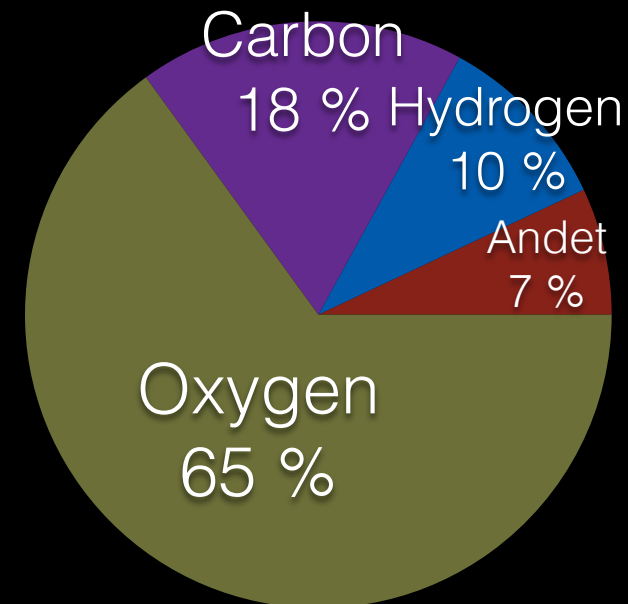
Universet



Jorden



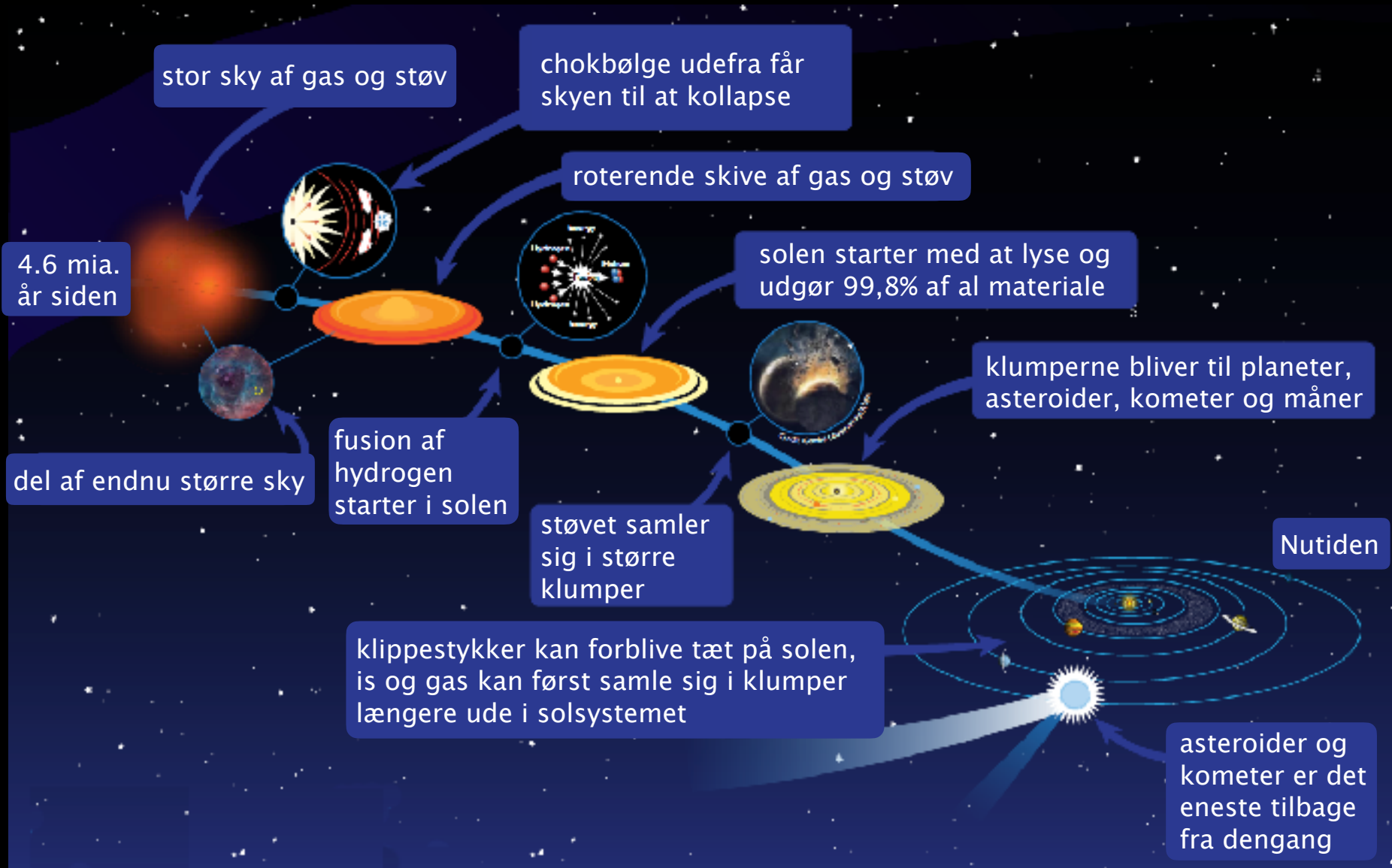
Mennesker



Forskellene kan forklares med af **mekanismerne** bag

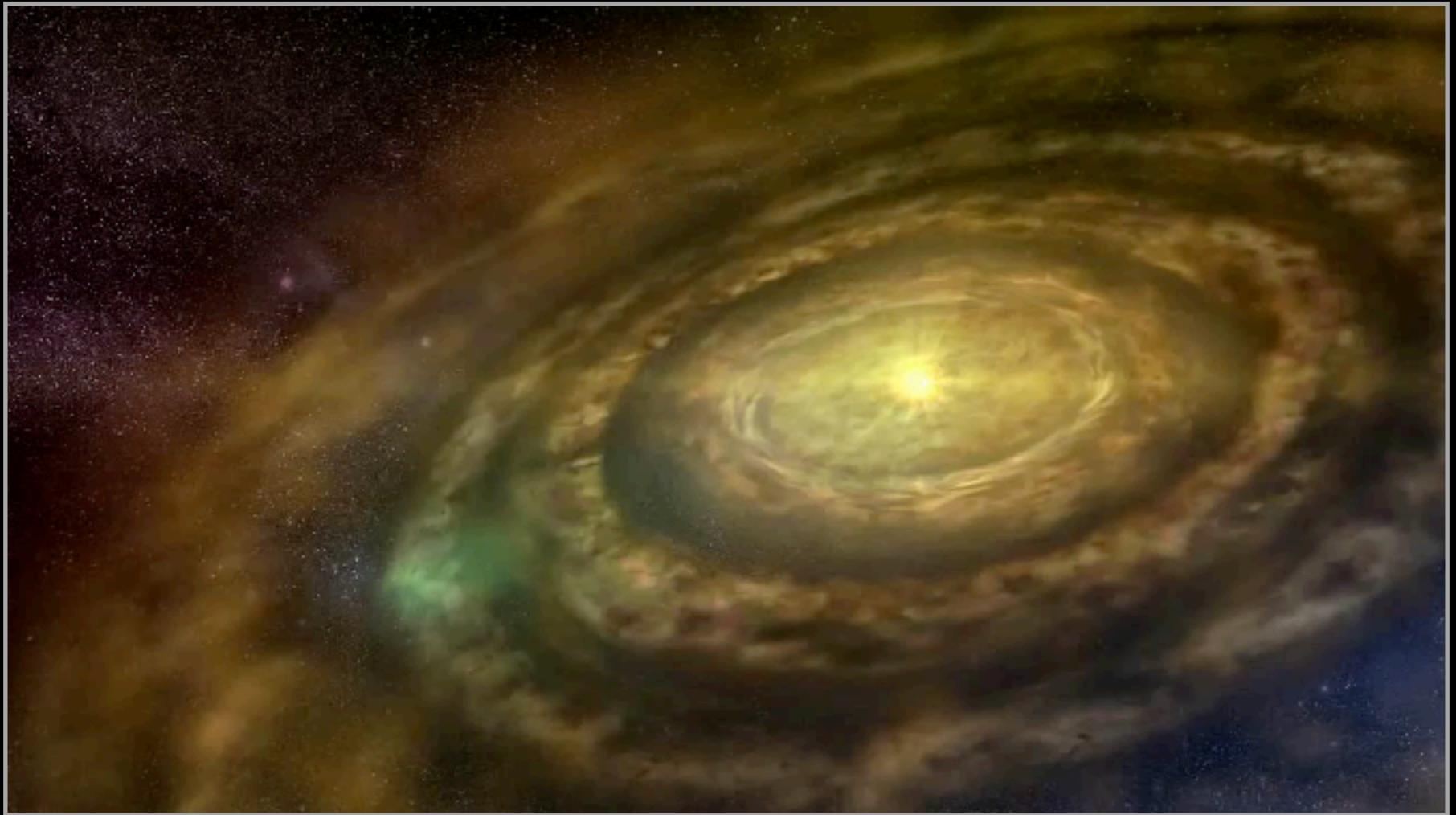
Solsystemets og jordens skabelse

4.6 milliarder år siden

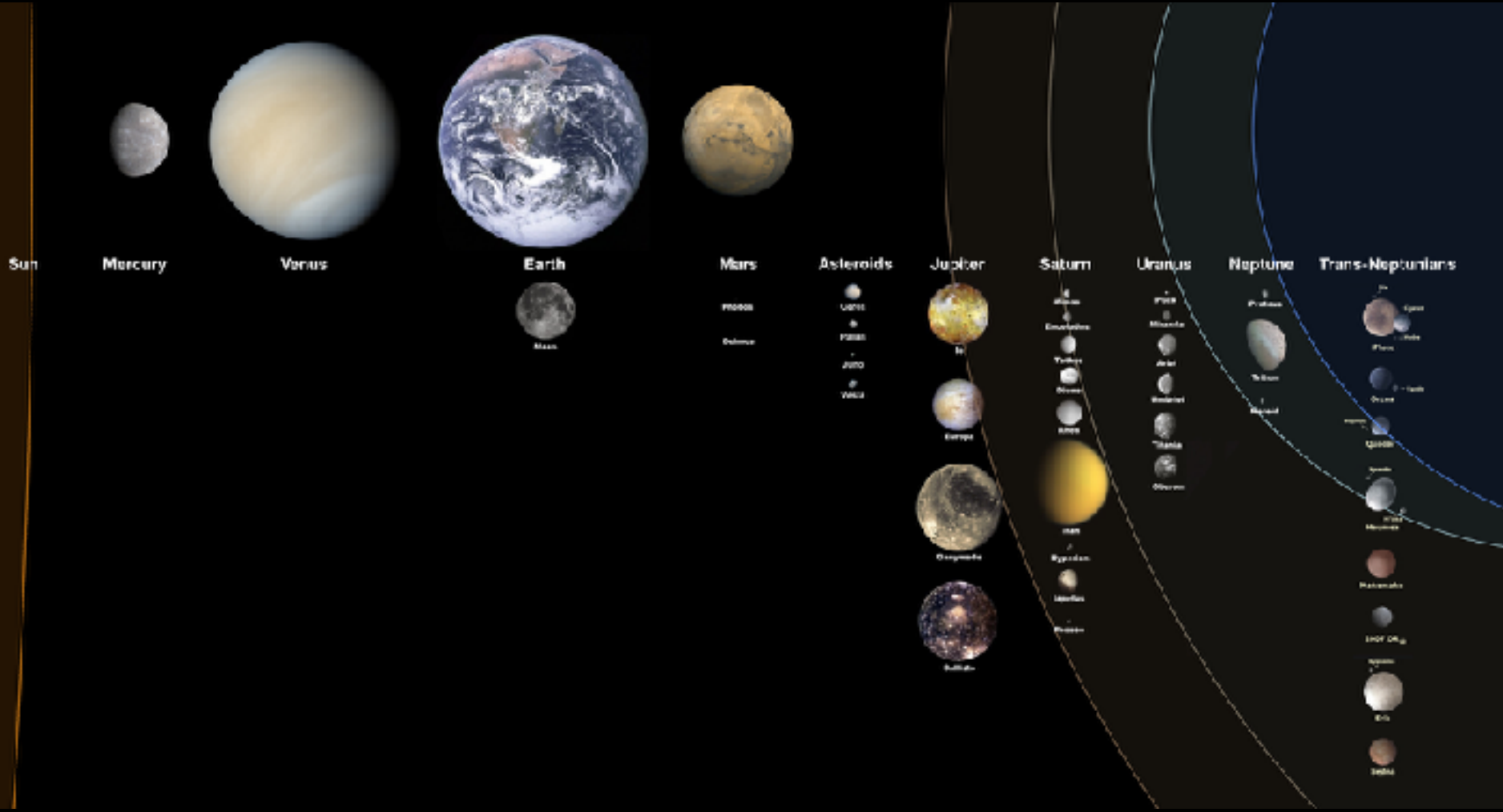


Solsystemets og jordens skabelse

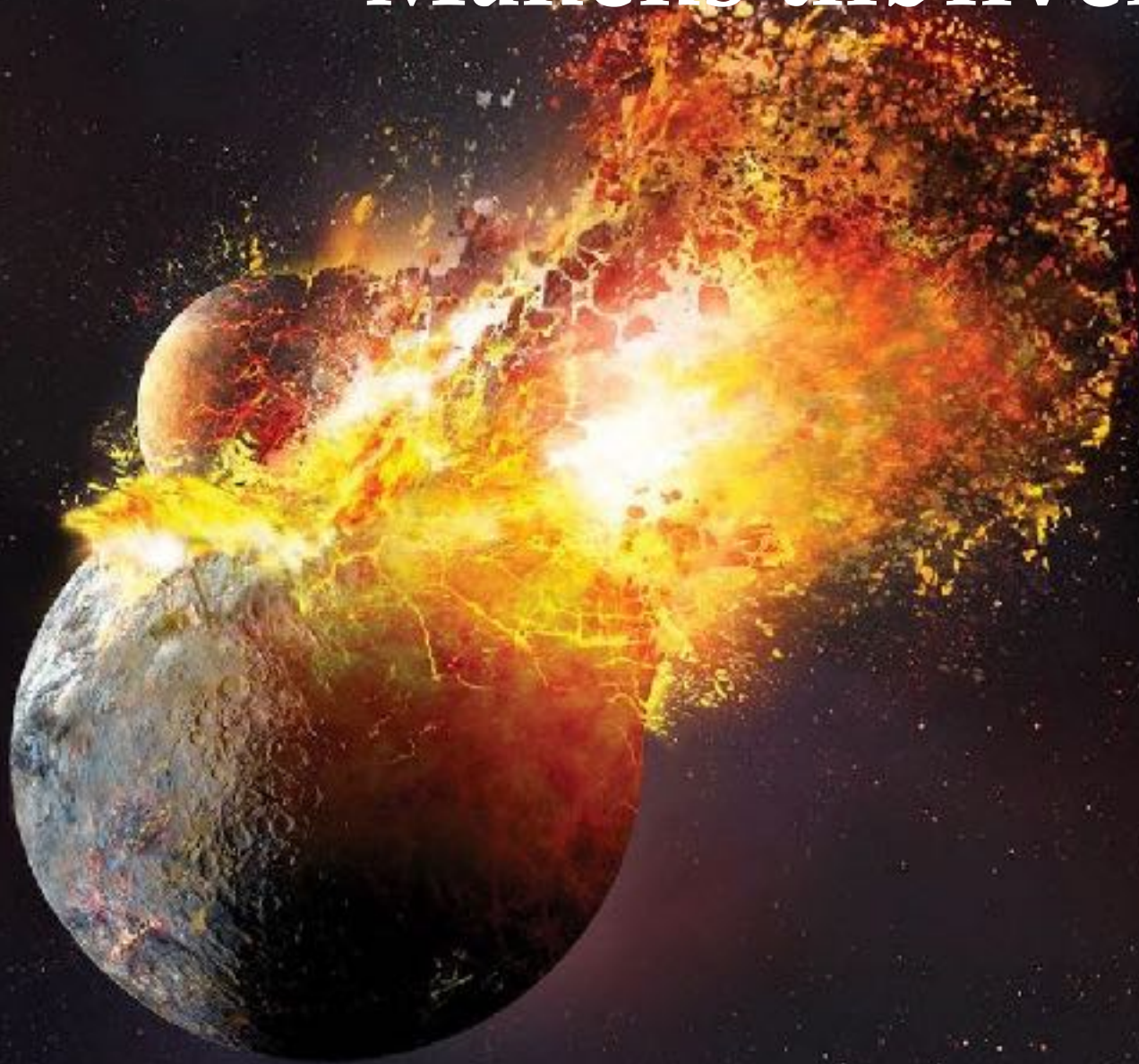
4.6 milliarder år siden



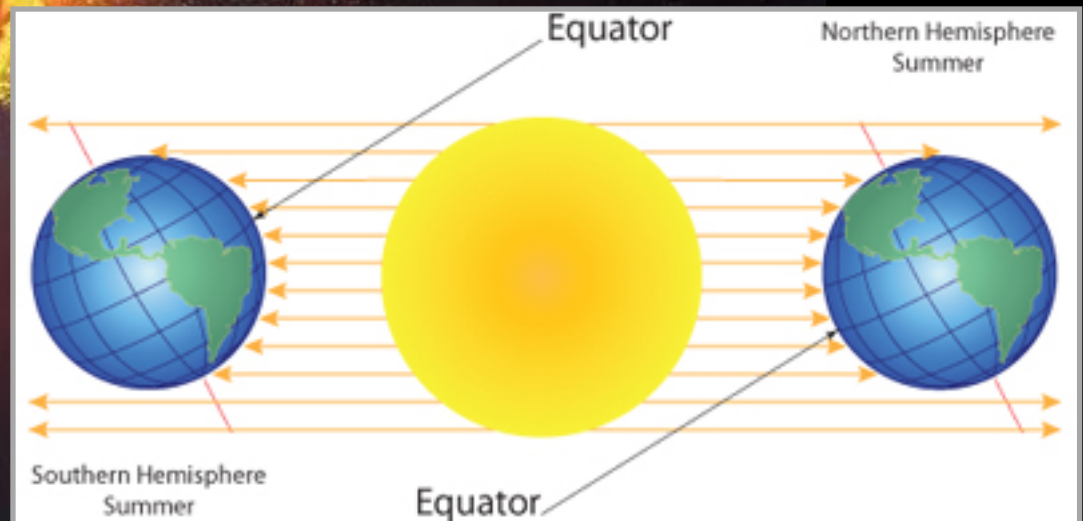
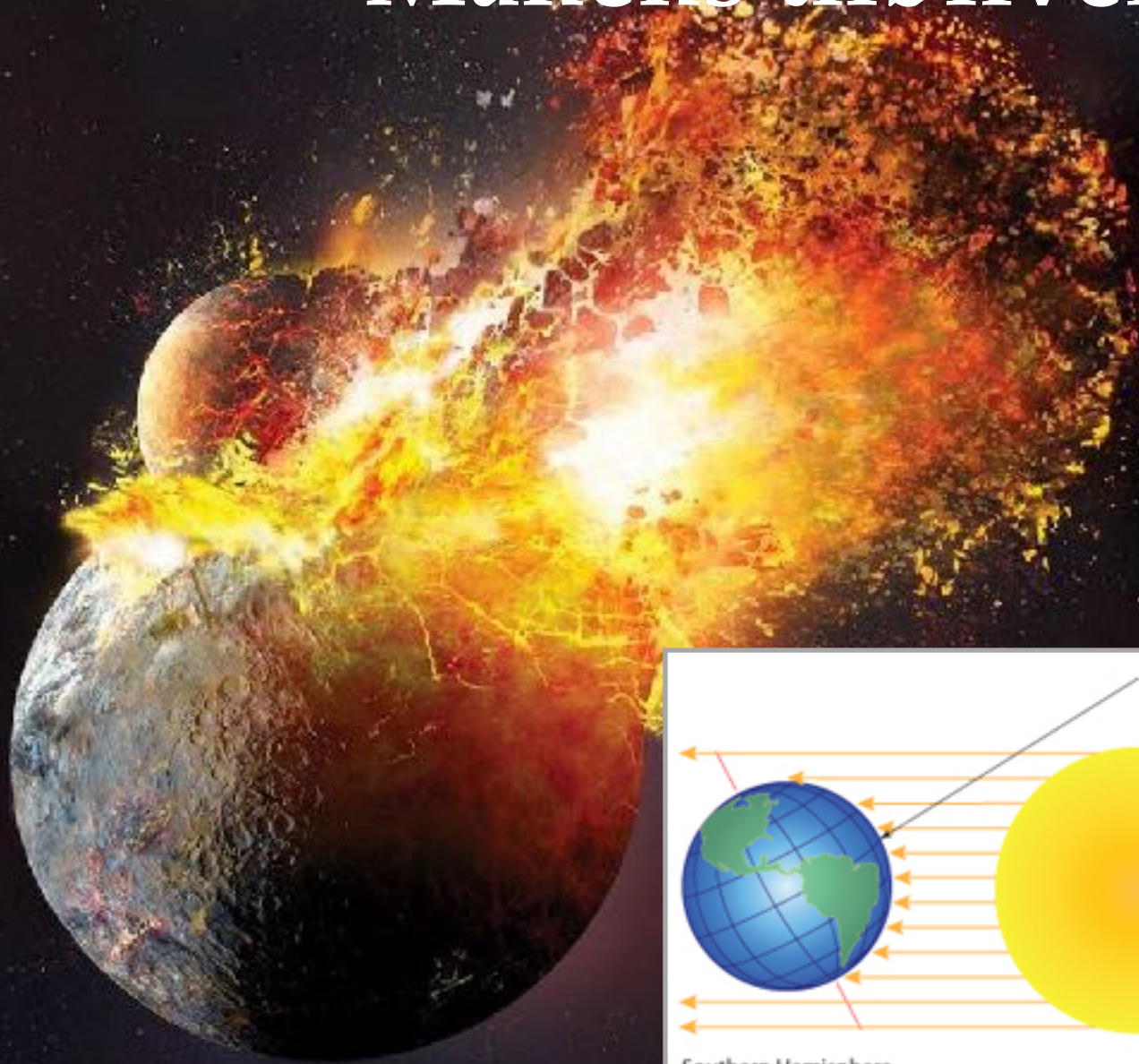
Solsystemets planeter



Månens tilblivelse



Månens tilblivelse



Vandet kommer til Jordan



Livet opstår på jorden

4 milliarder år siden

Al liv vi kender

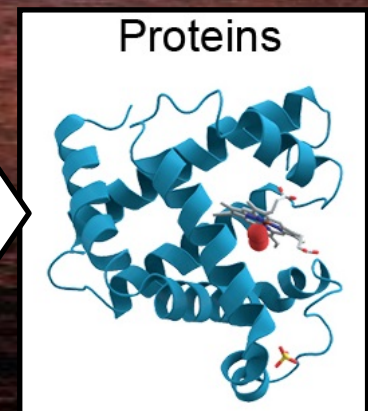
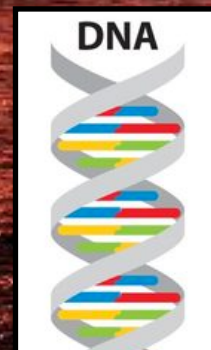
- **kopierer** sig selv
- **befinder** sig i en **celle**
- **forbruger energi**

Livet opstår på jorden

4 milliarder år siden

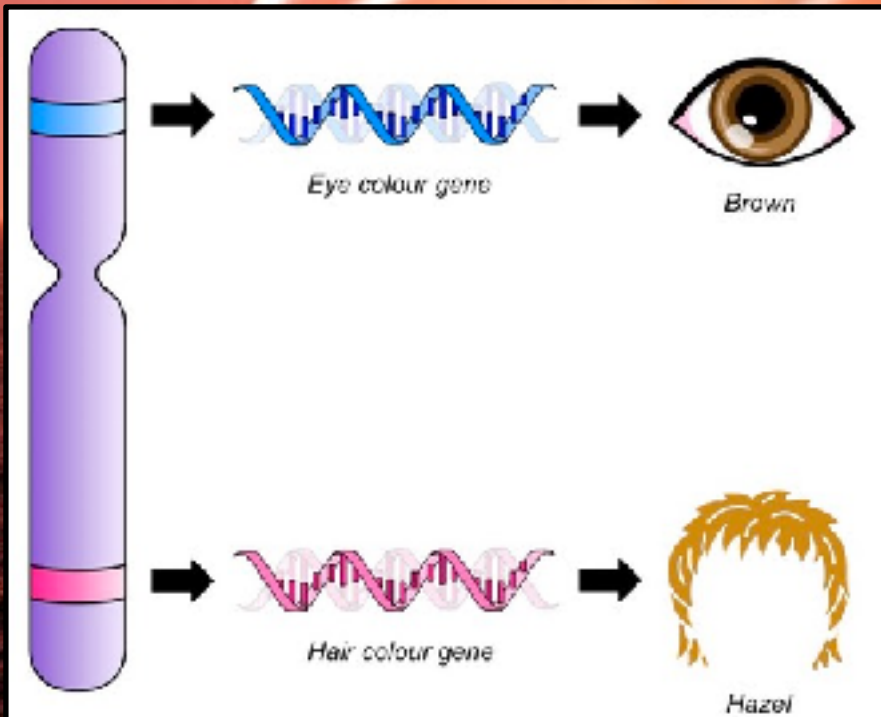
Al liv vi kender

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



Livet opstår på jorden

4 milliarder år siden

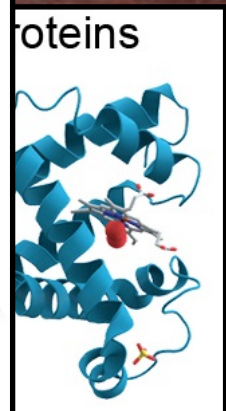
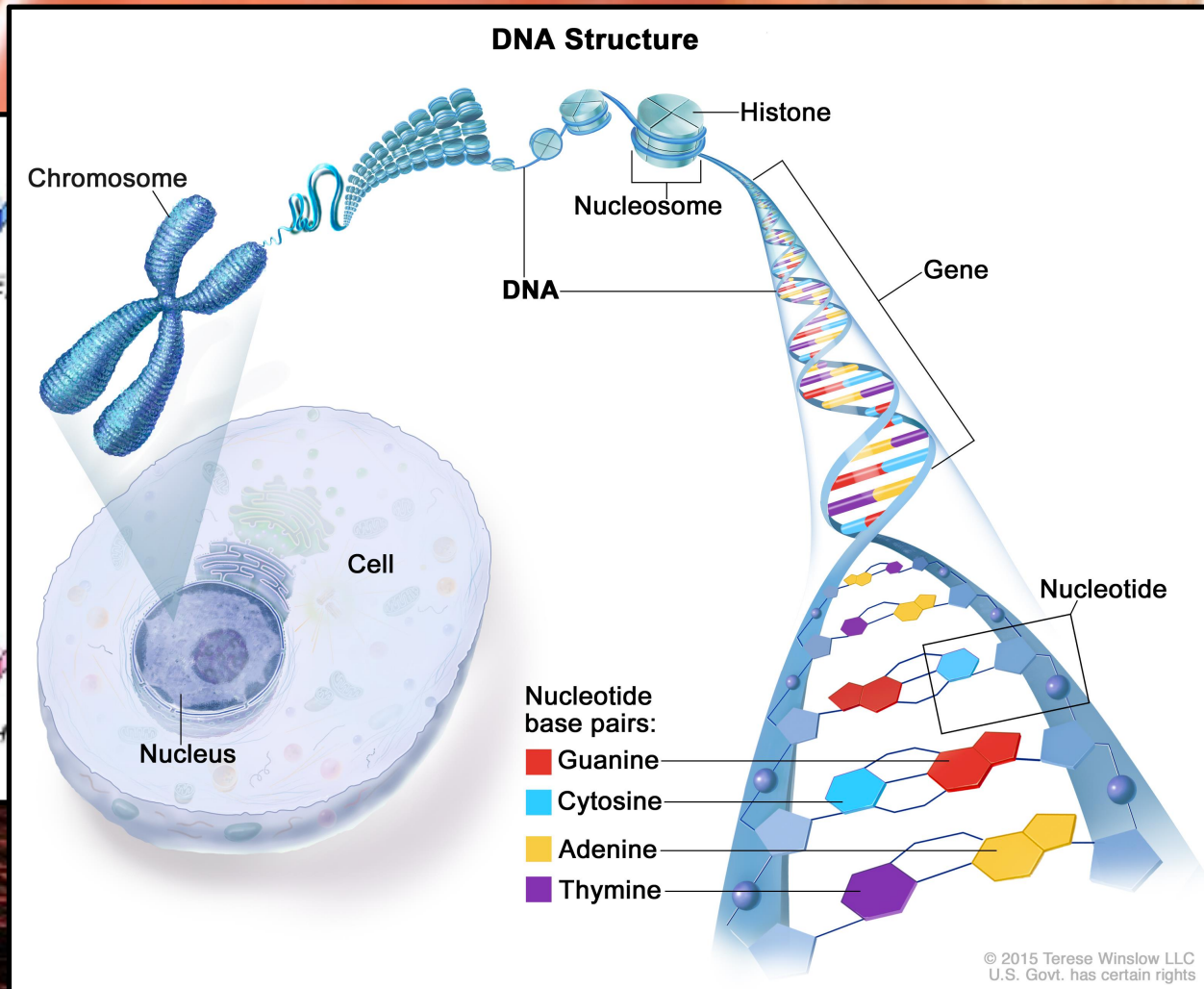
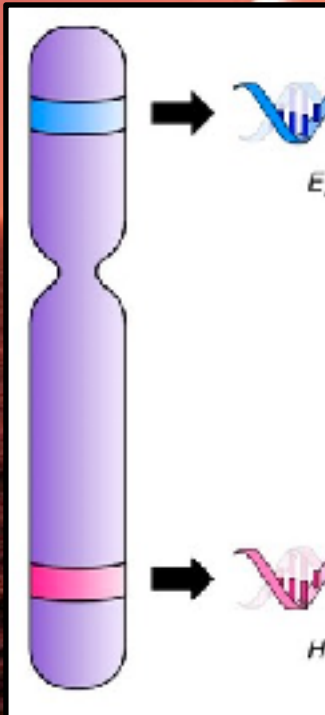


Kopiering



Livet opstår på jorden

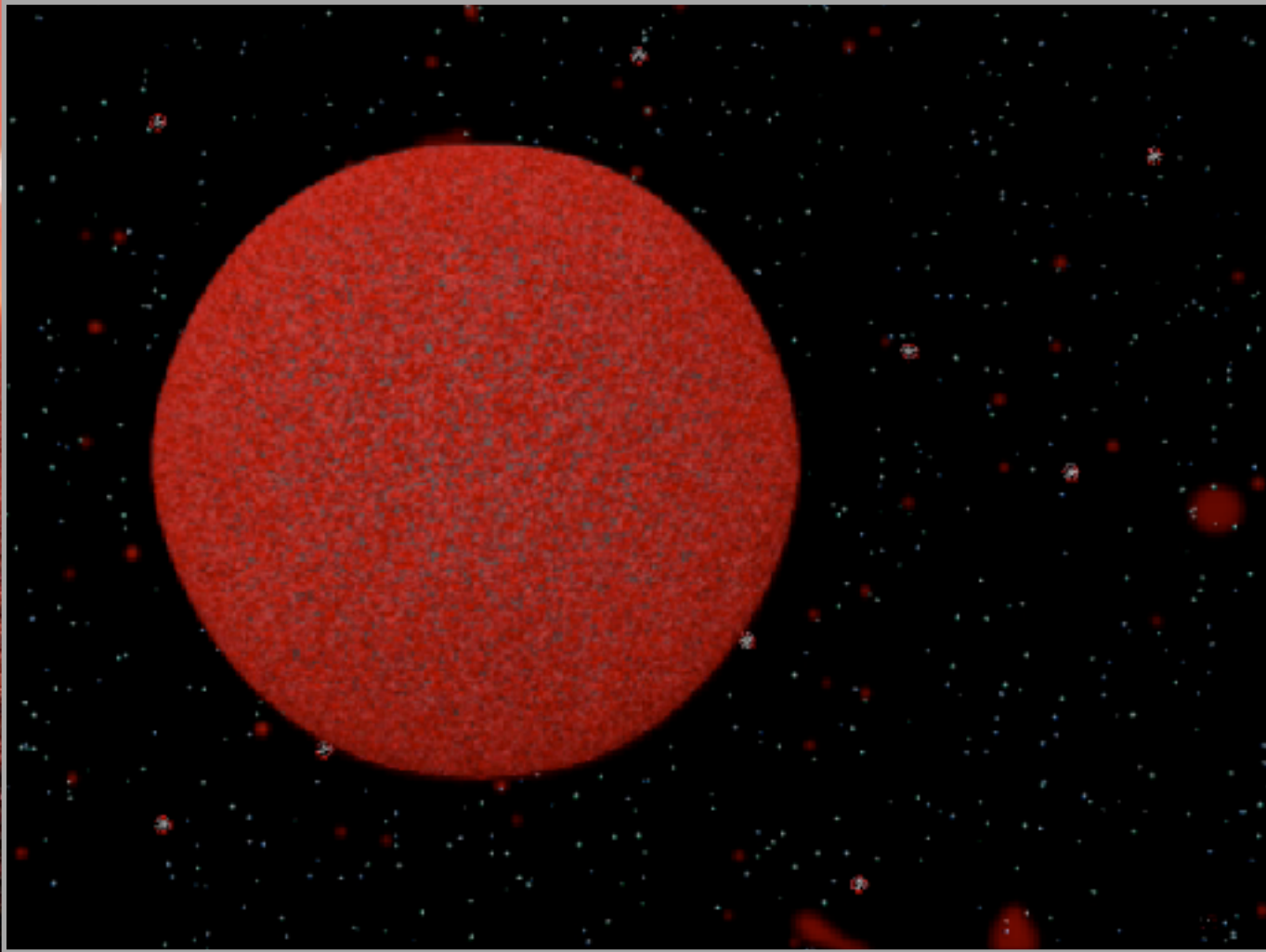
4 milliarder år siden



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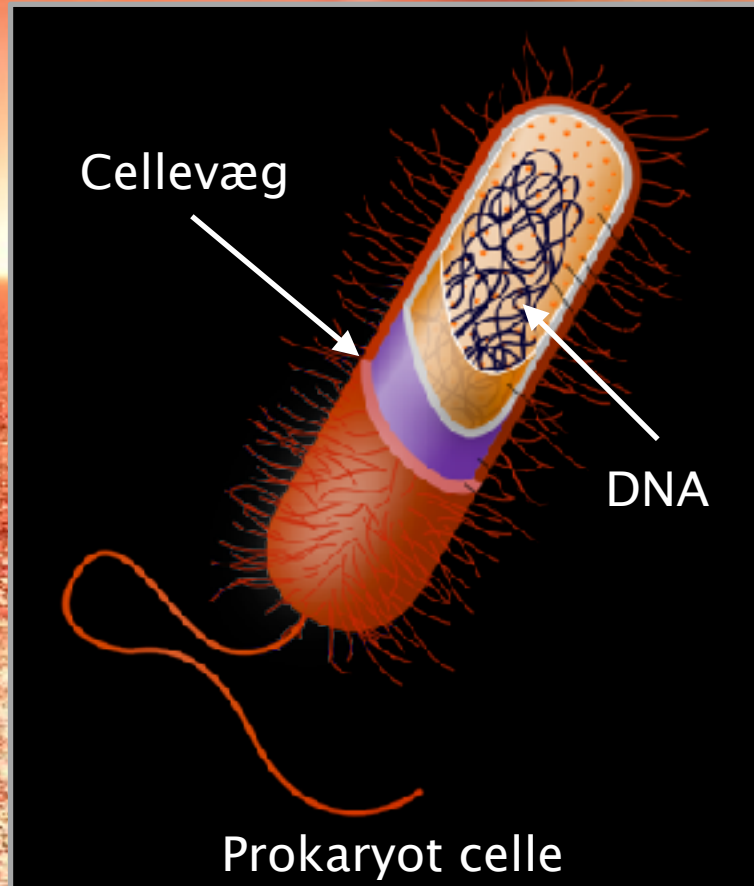
Livet opstår på jorden

4 milliarder år siden



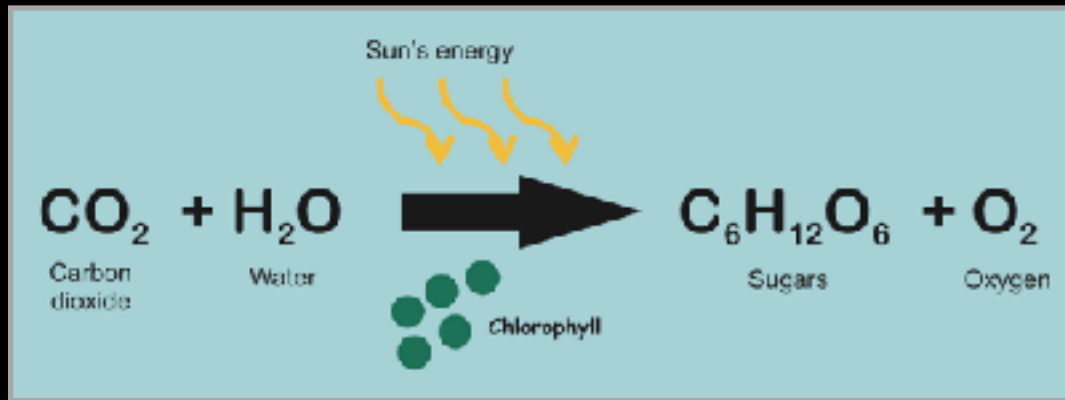
Livet opstår på jorden

4 milliarder år siden

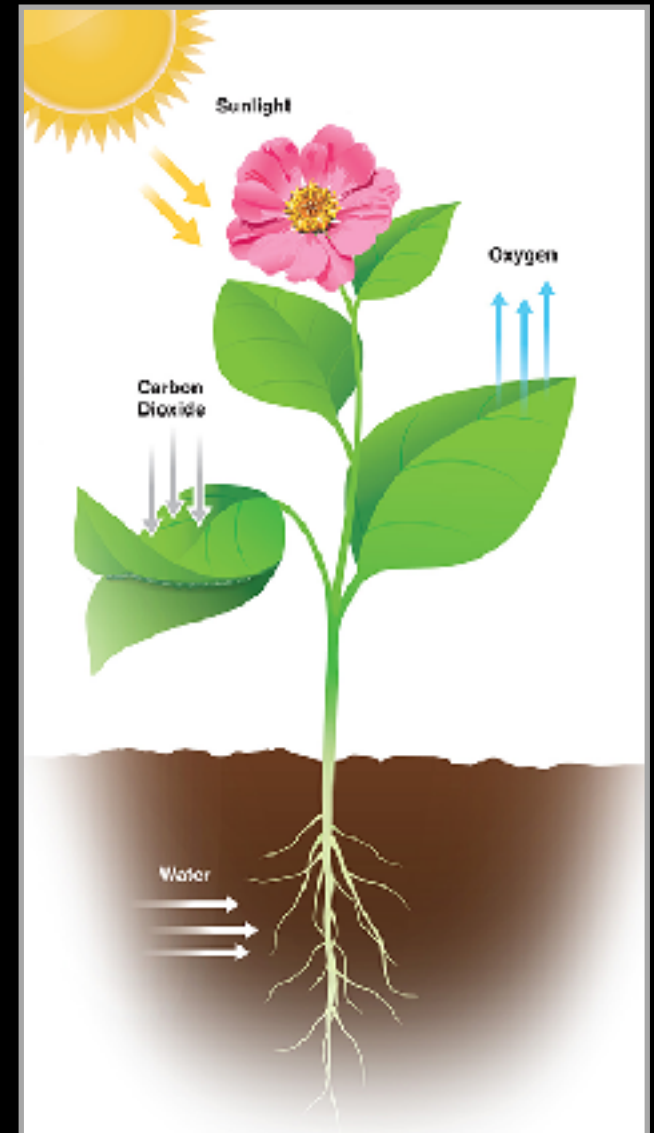


Fotosyntese - Energi til liv

~3.0-3.5 milliarder år siden

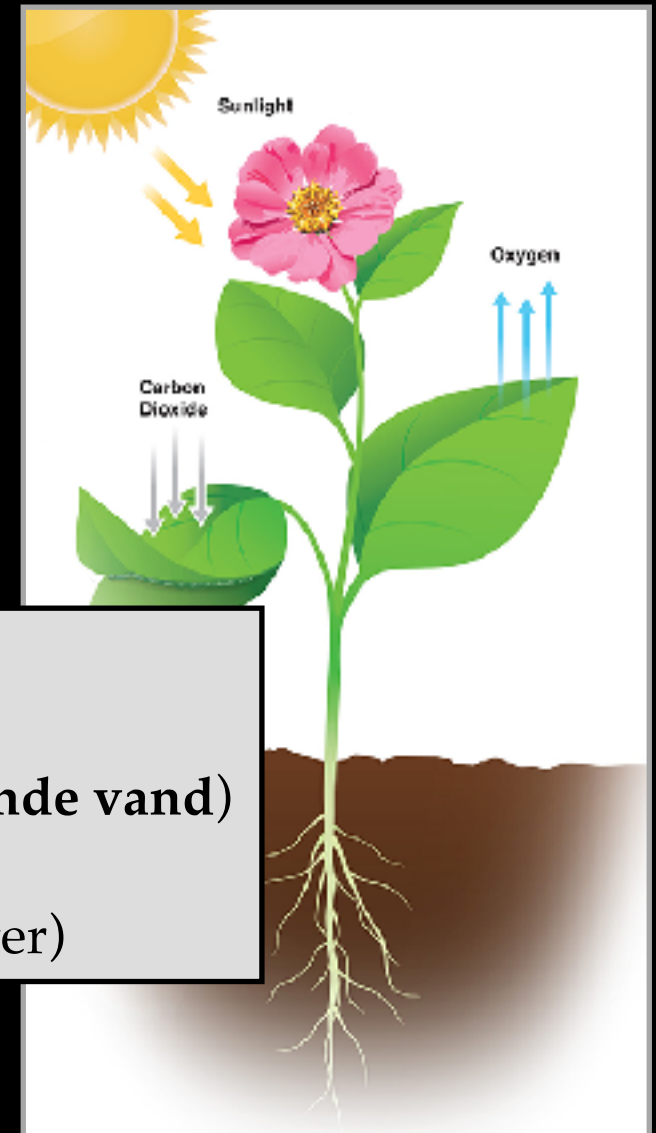
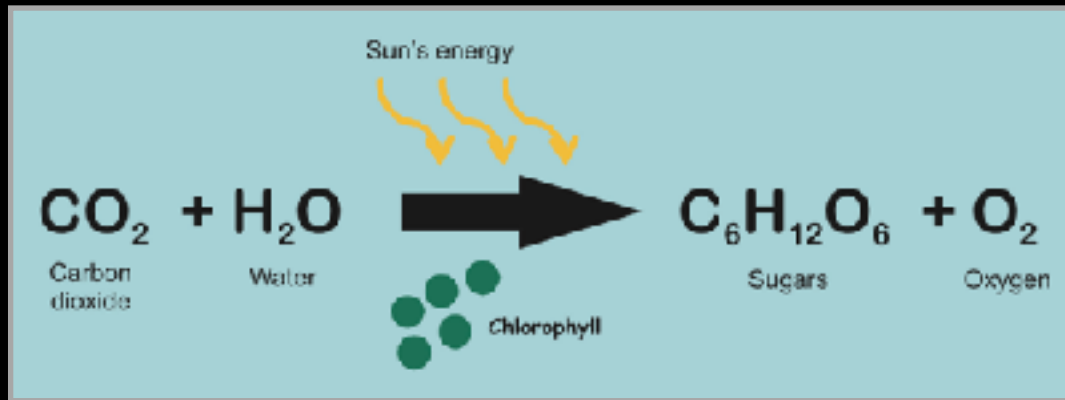


- På 1 m² på jorden kommer der:
- Indefra: < 0.1 Watt (varme)
 - Fra solen: 340 Watt



Fotosyntese - Energi til liv

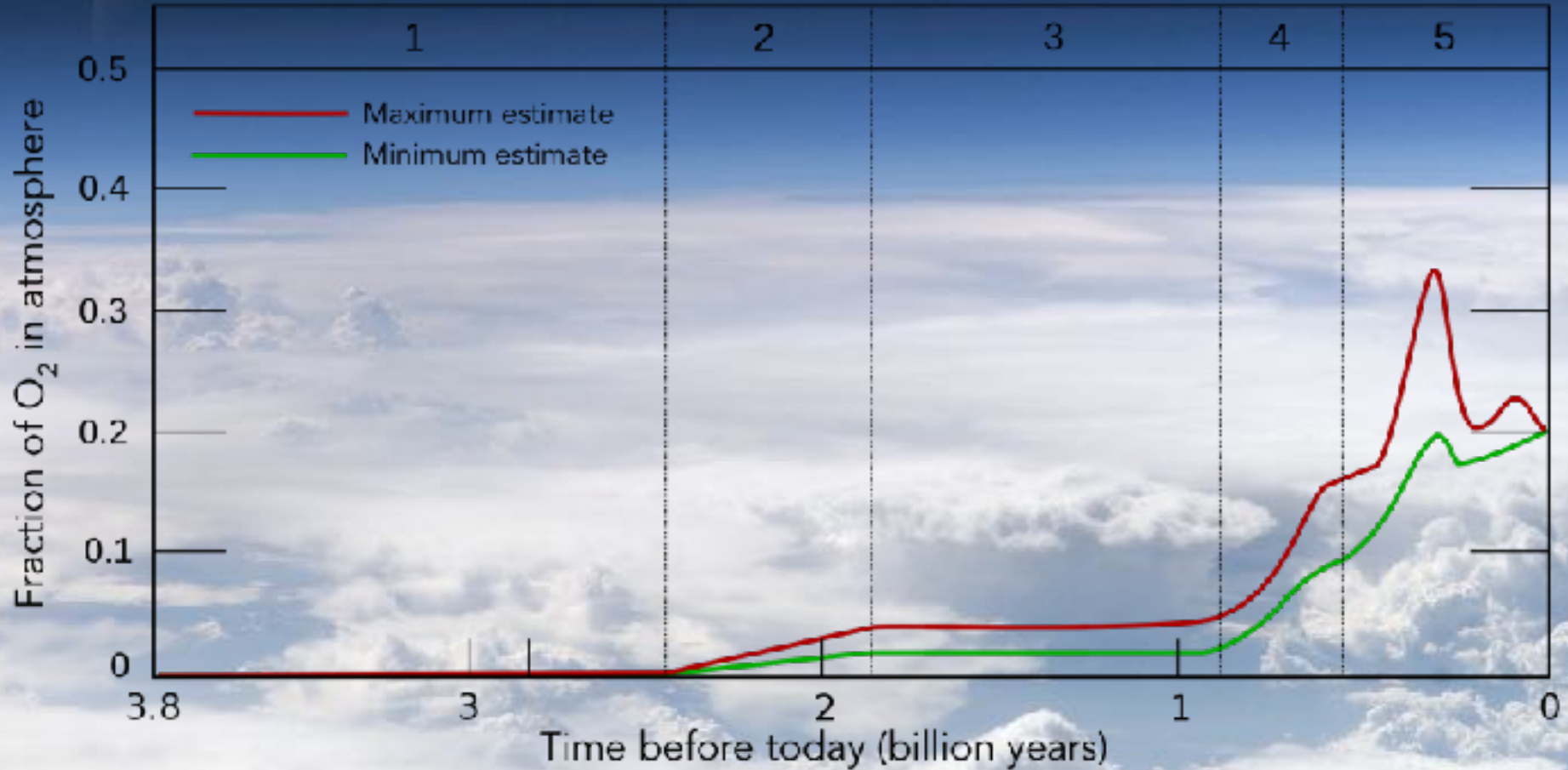
~3.0-3.5 milliarder år siden



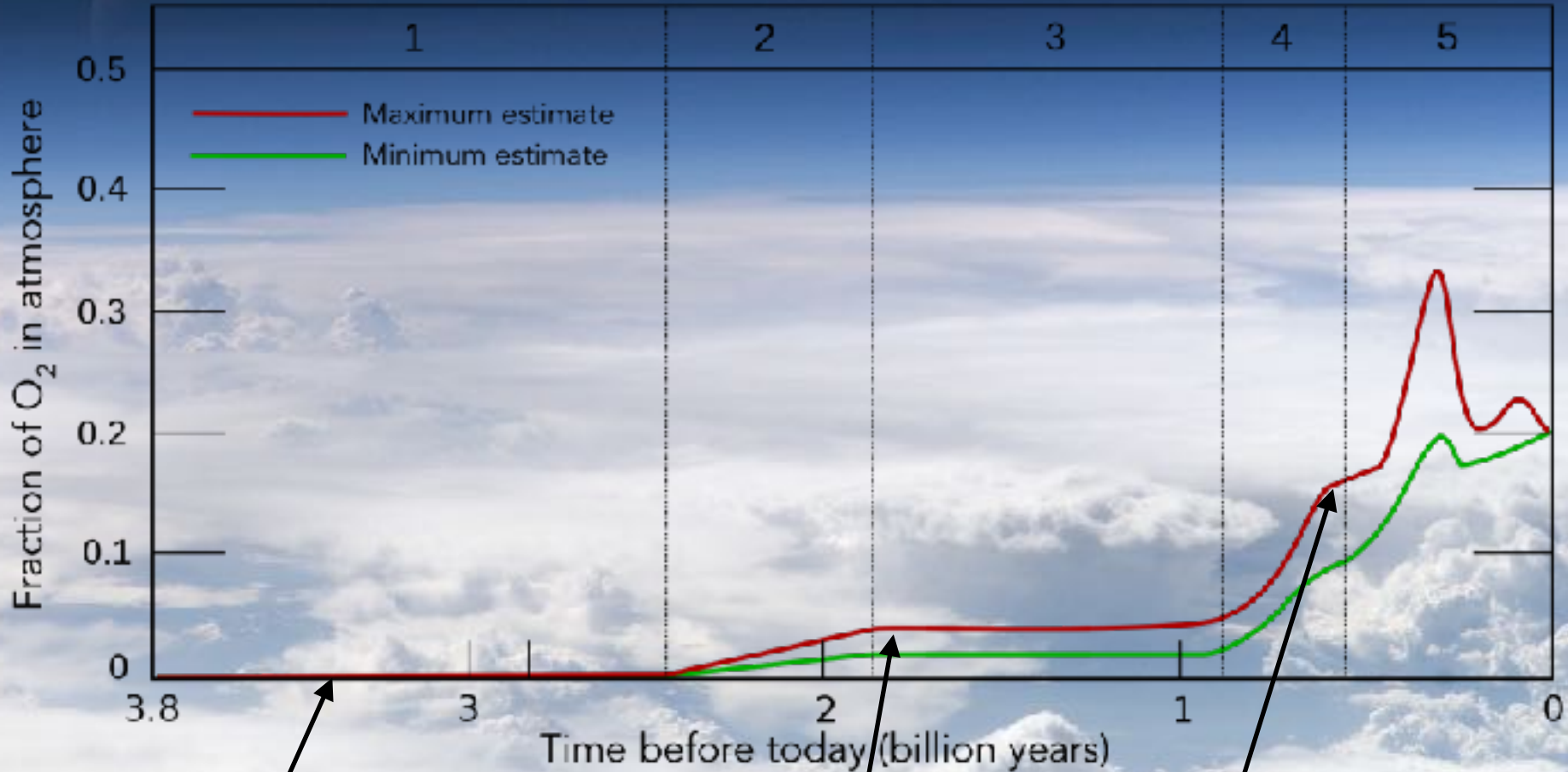
Fotosyntesen er helt central af tre grunde:

- De atomer der indgår, er **overalt**
- Den definerer den beboelige zone (**flydende vand**)
- Den fortæller hvordan **O₂** 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

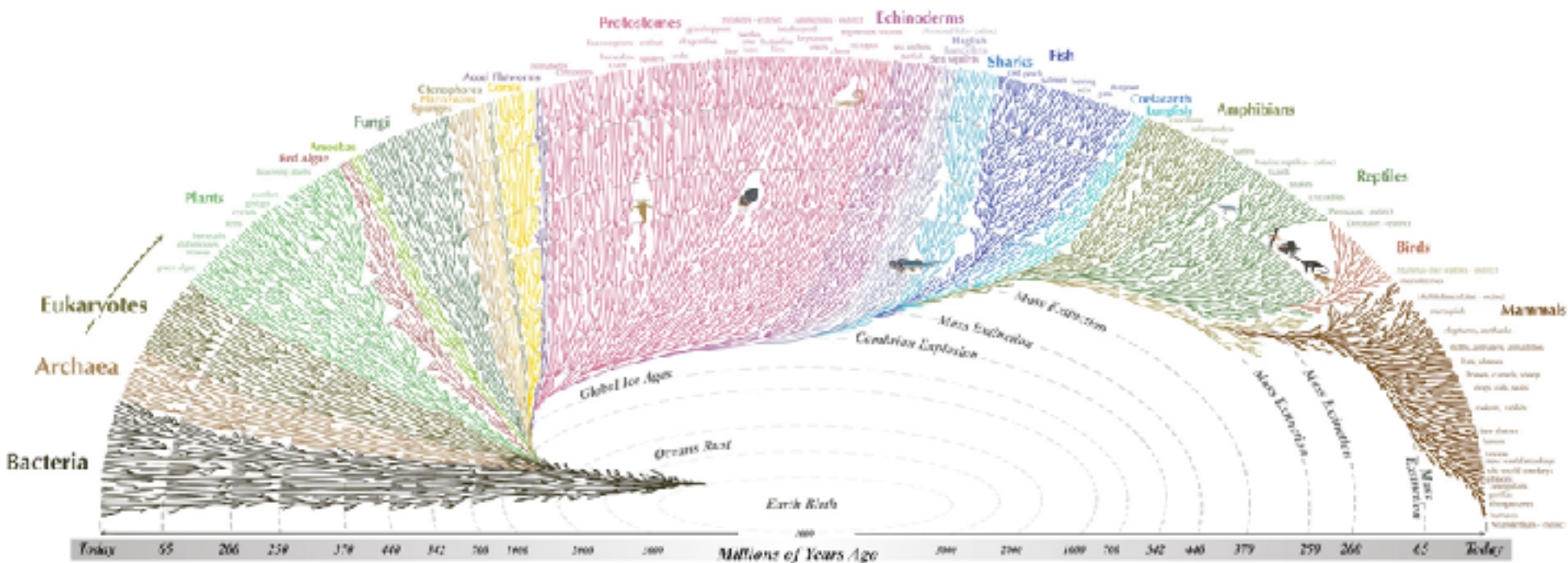
Så følger en rivende udvikling:

- 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**



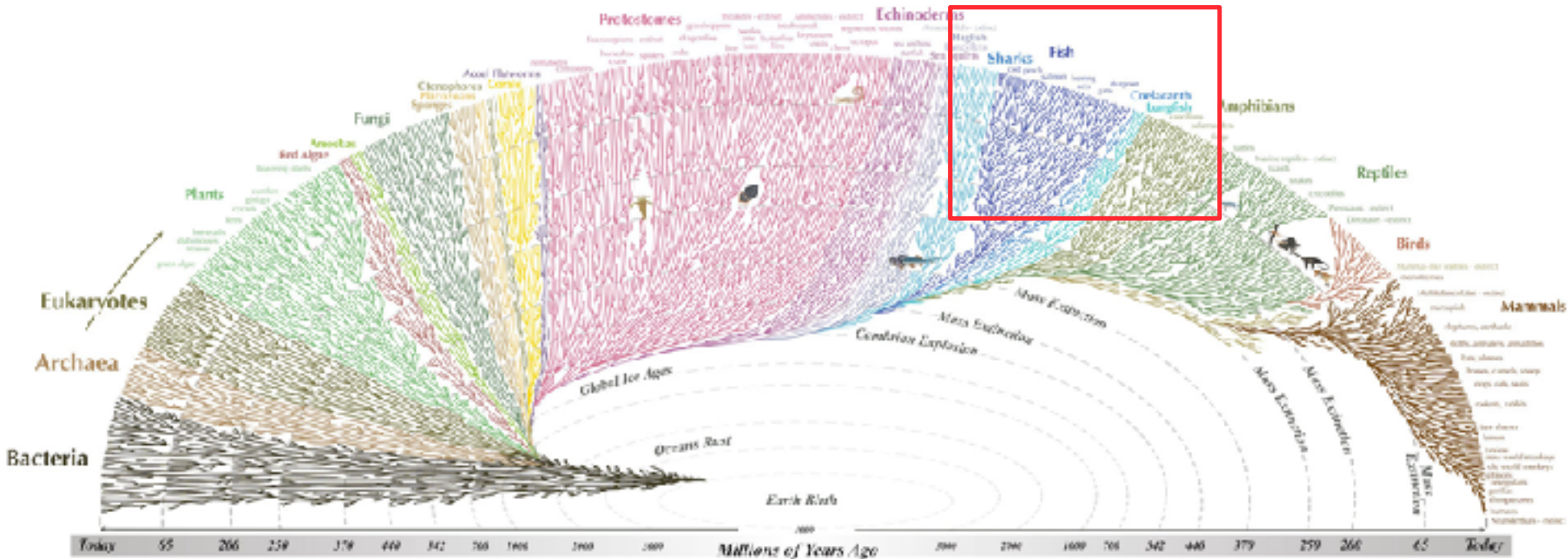
Livets familietræ



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

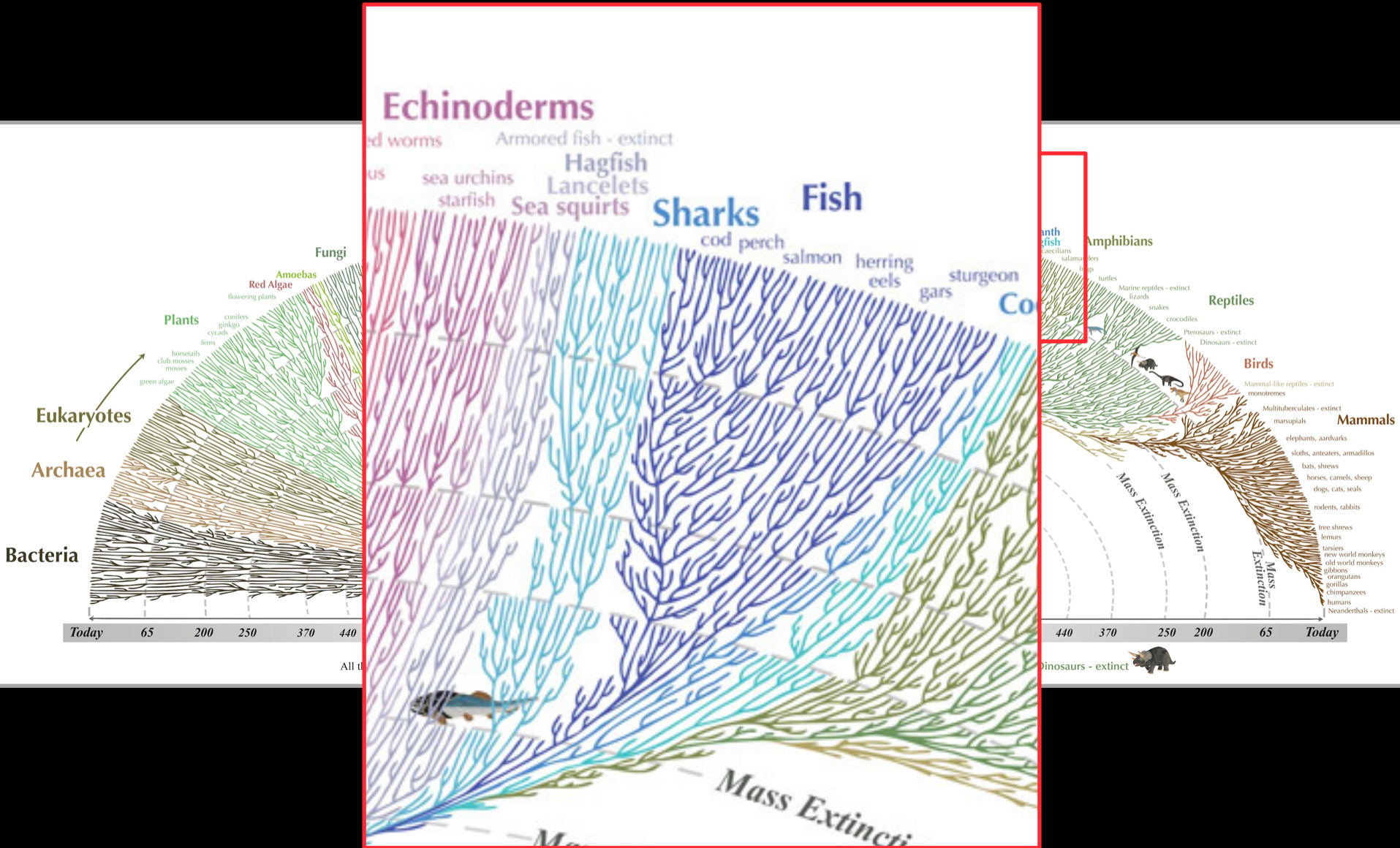
[Se mere på evogeneao](#)

Livets familietræ

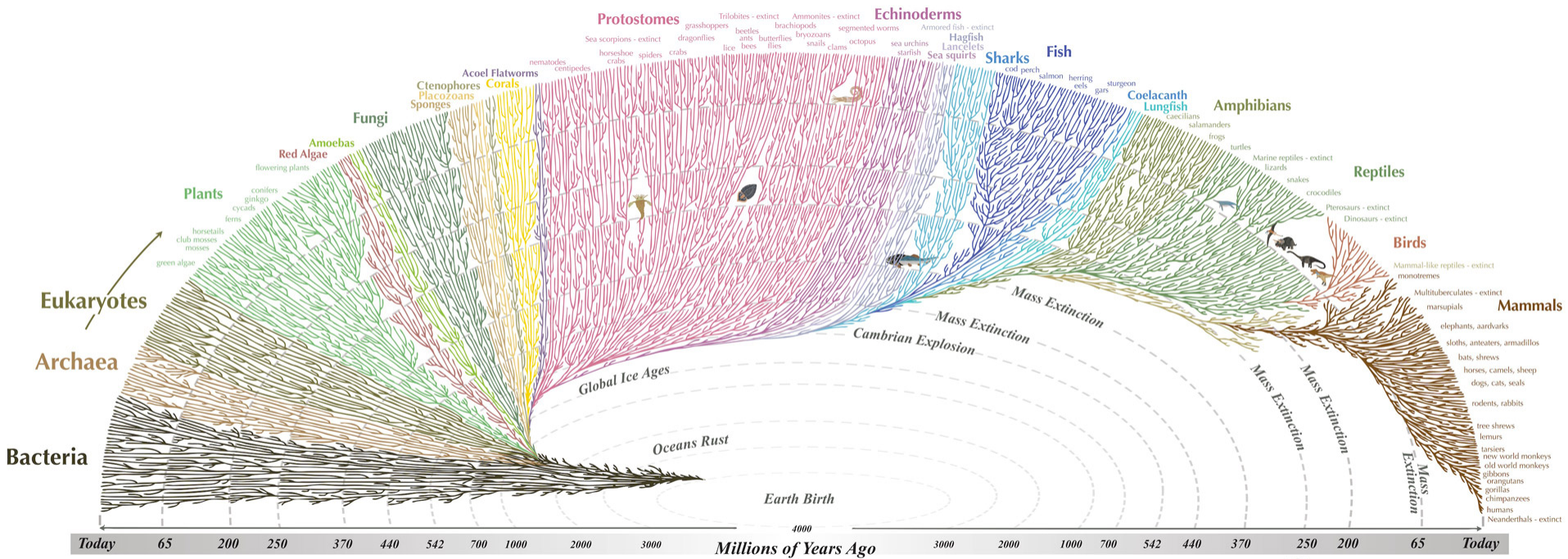



NI. De major and many of the major living branches of life are shown in this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaur (with a small dinosaur icon)

Livets familietræ

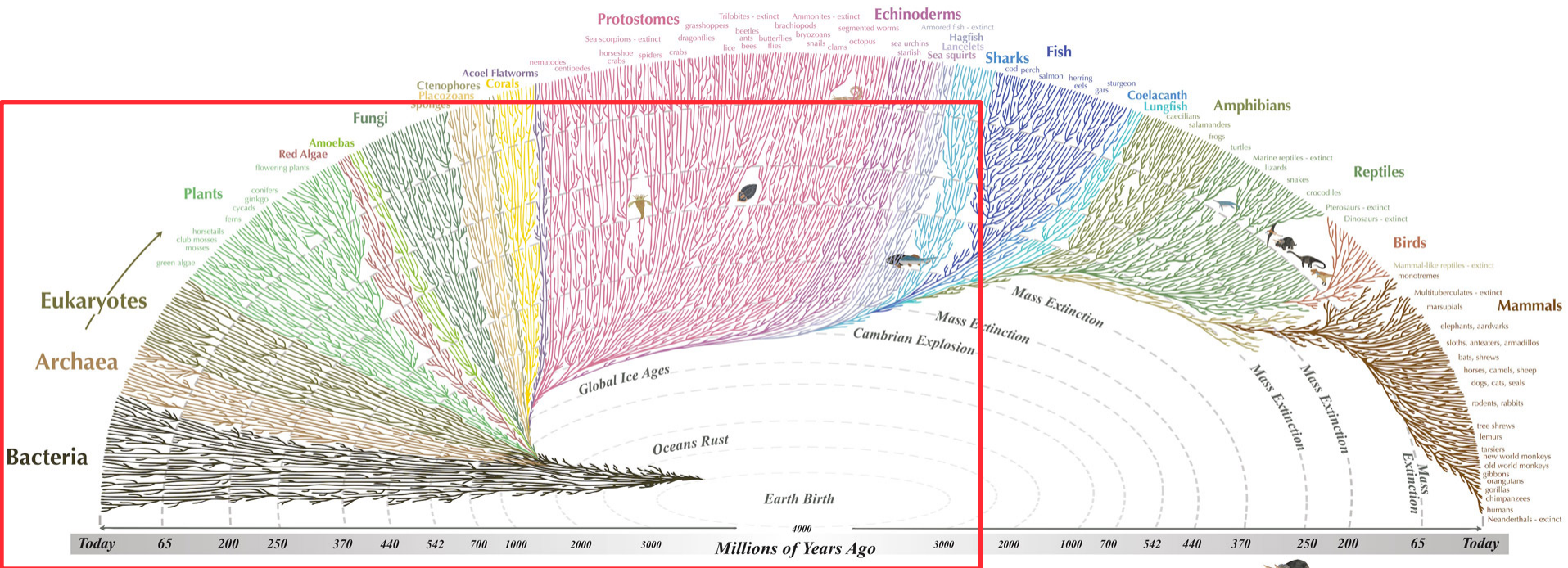



Livets familietræ



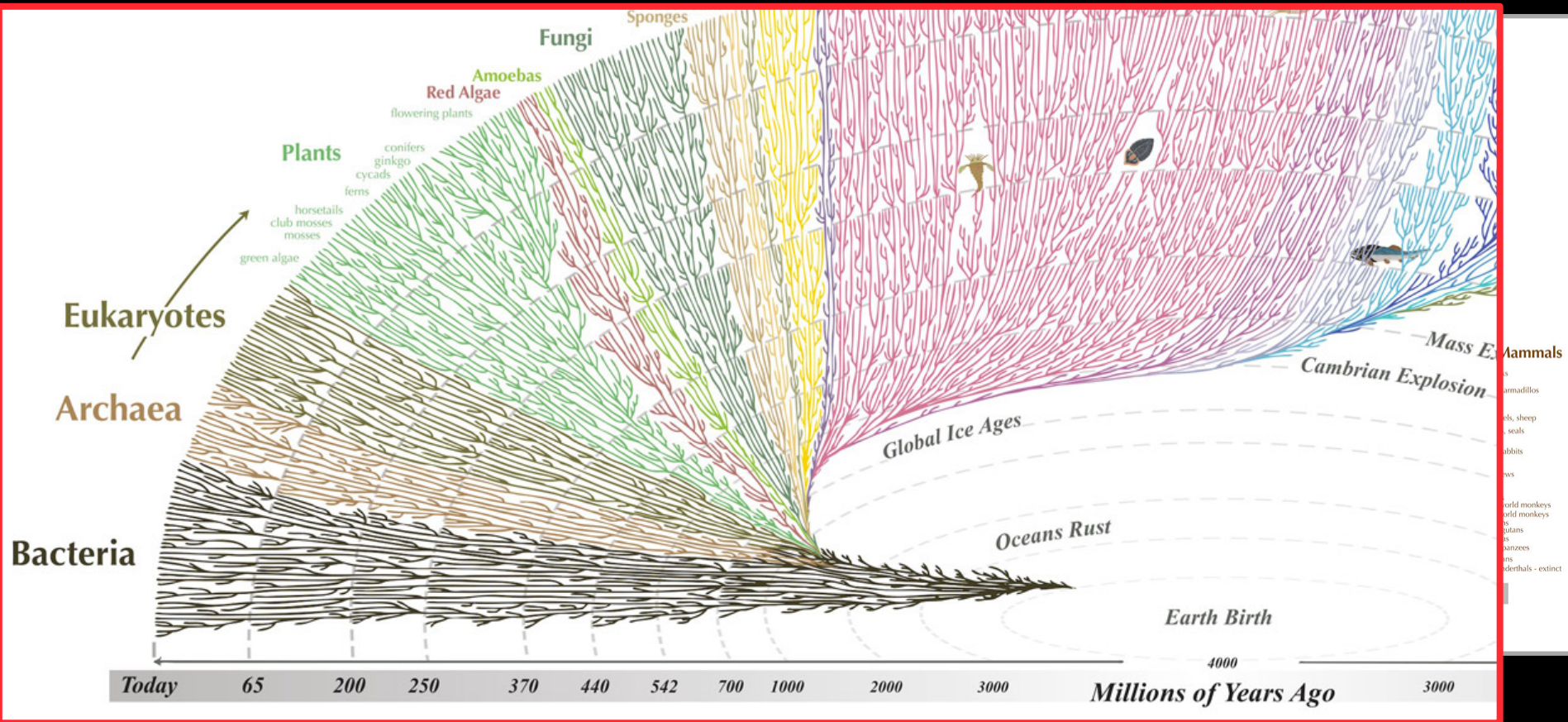
All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct 

Livets familietræ

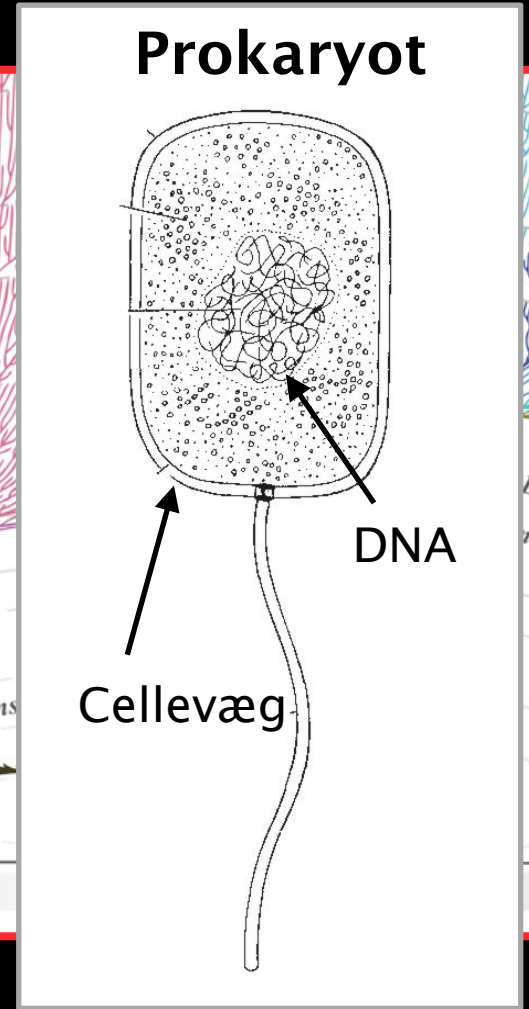
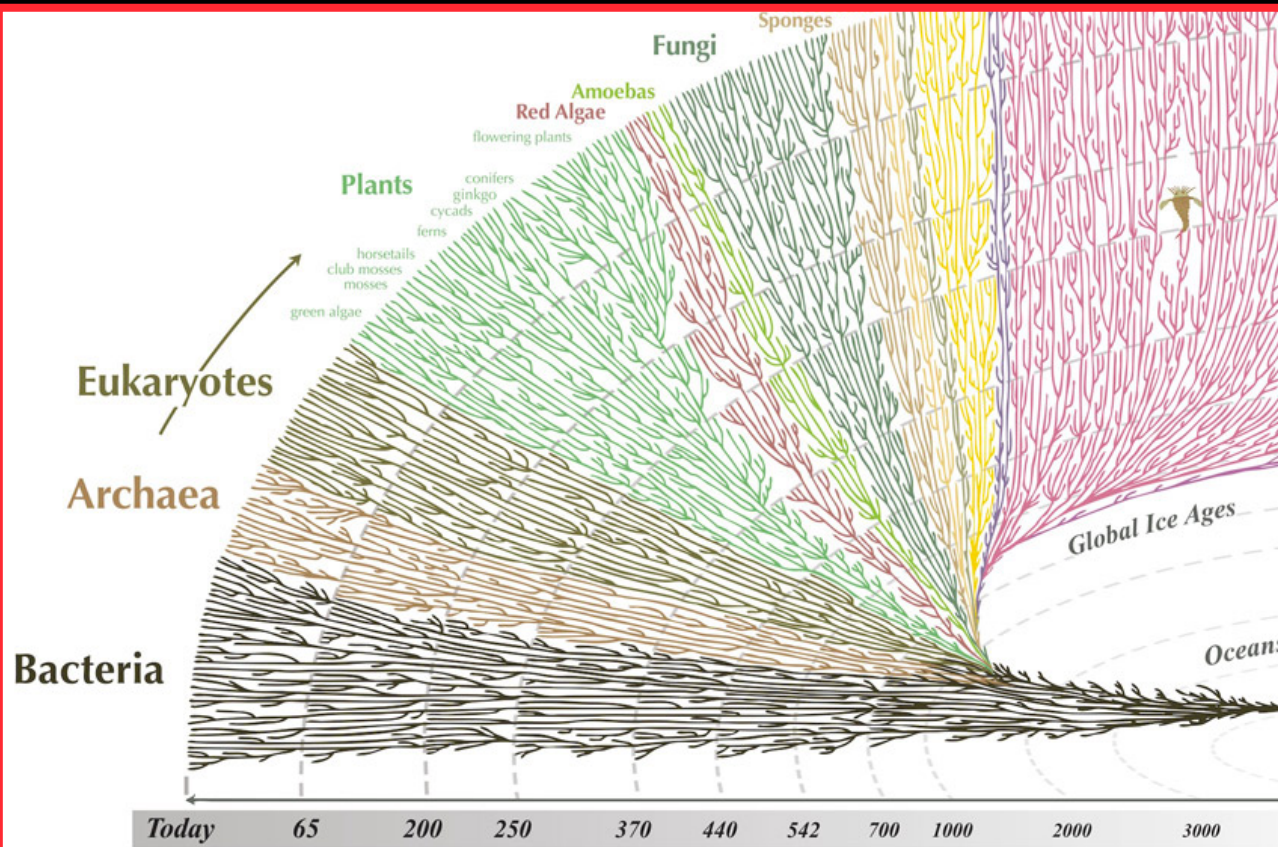


All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct 

Livets familietræ

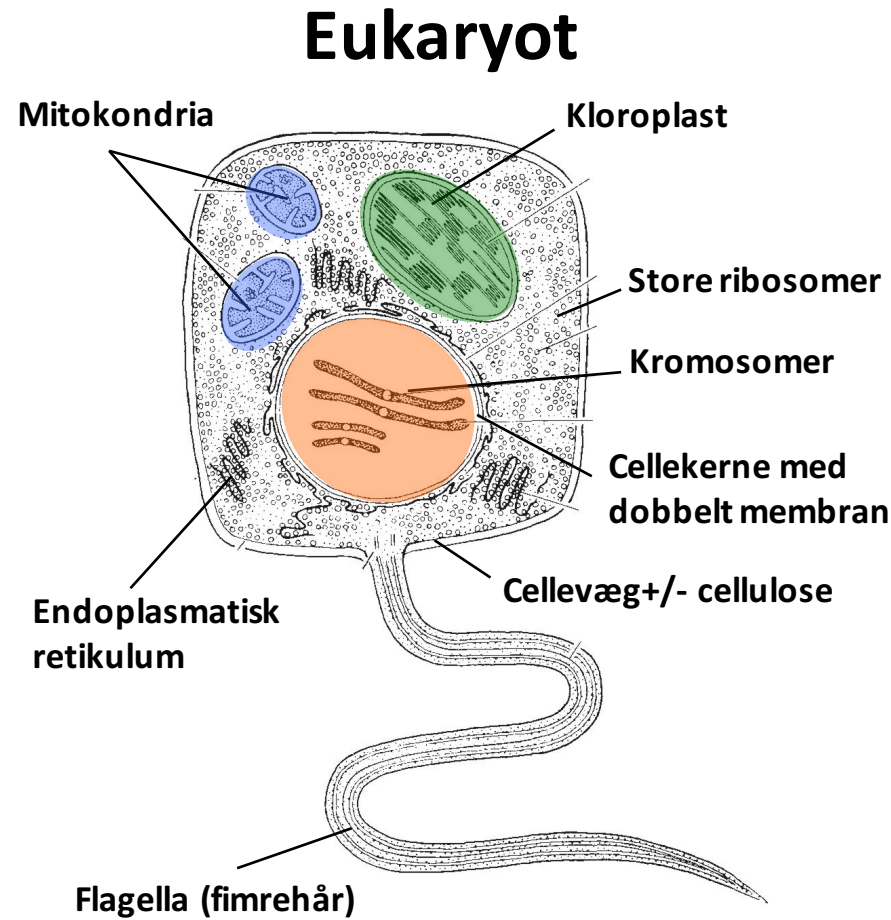
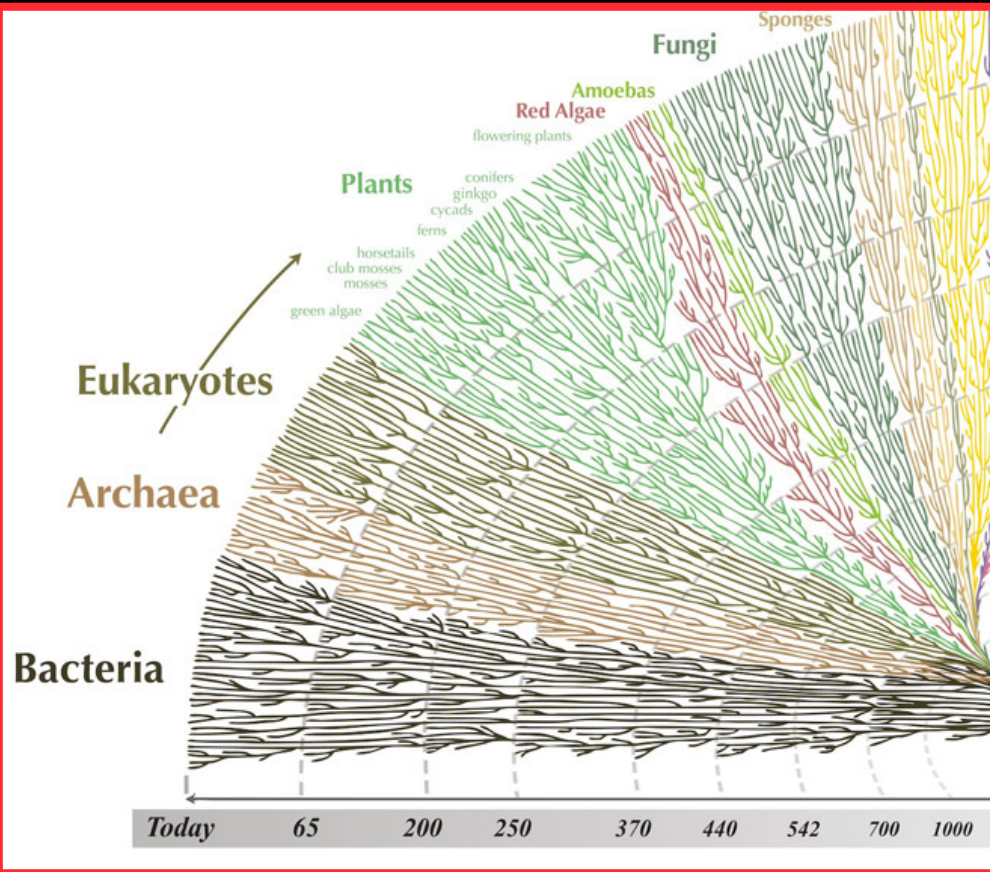


Livets familietræ

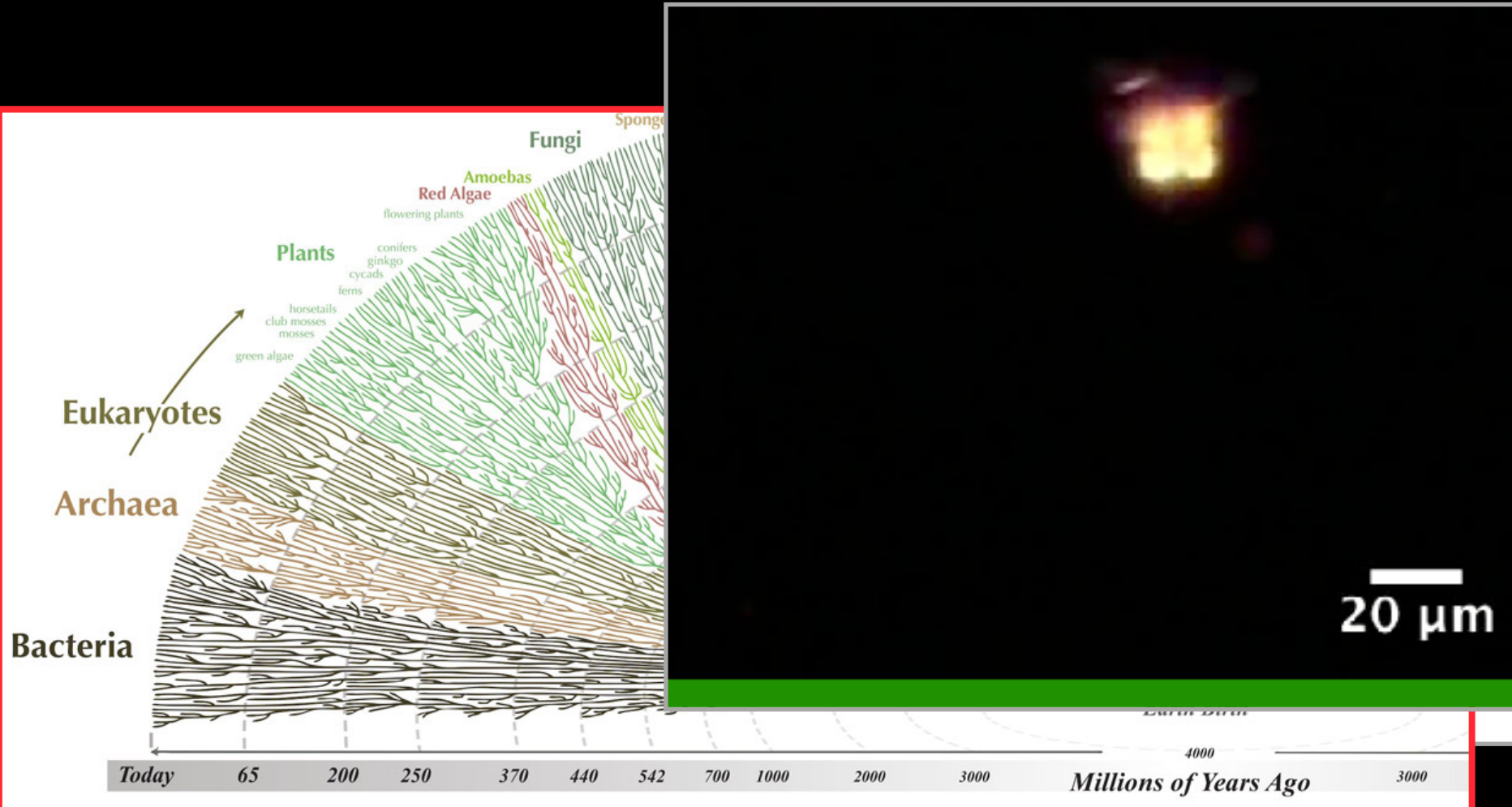


Mammals
s
armadillos
els, sheep
seals
rabbits
sws
wild monkeys
wild monkeys
nutans
sanzes
ms
dethals - extinct

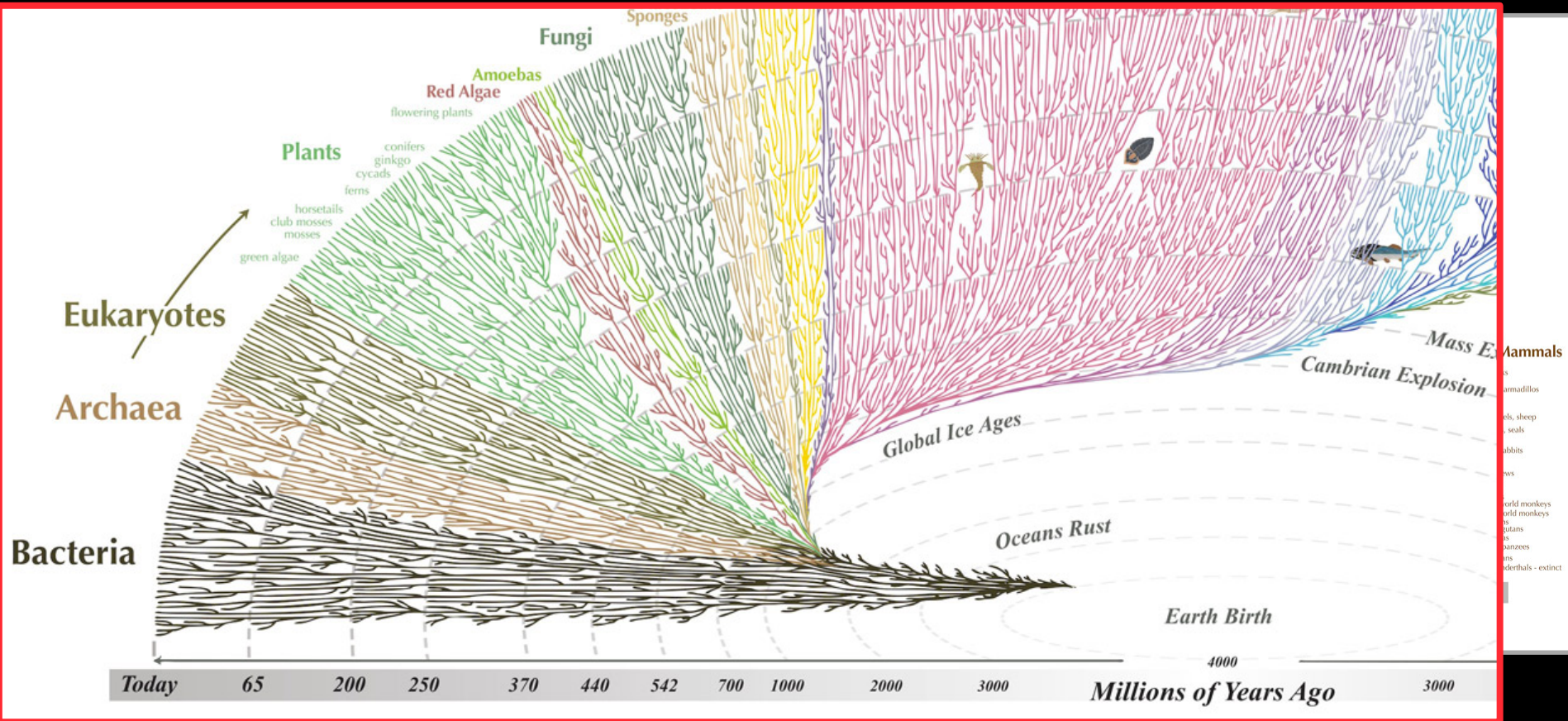
Livets familietræ



Livets familietræ

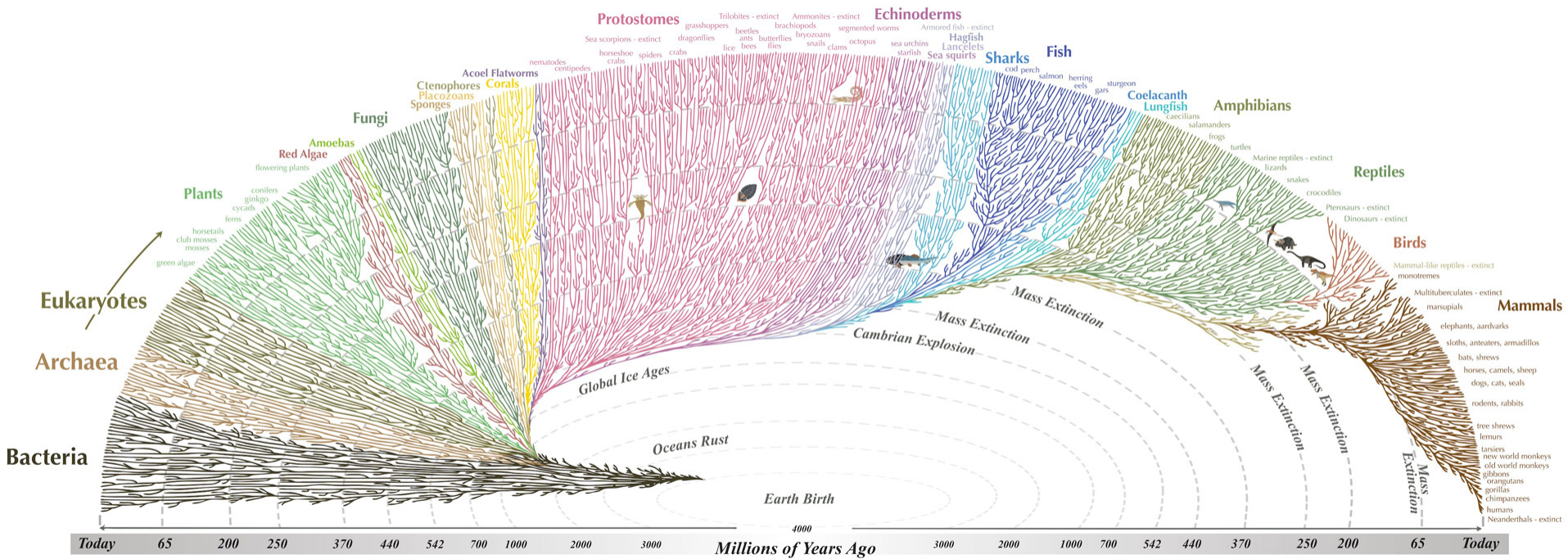



Livets familietræ



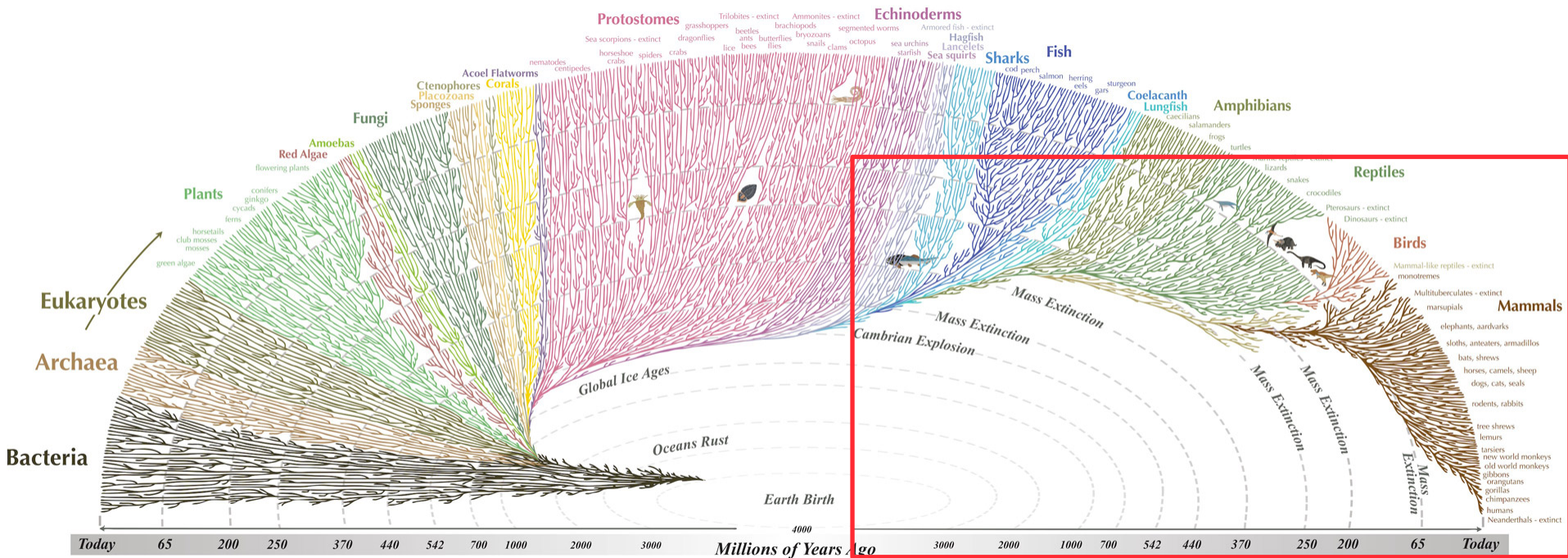
Alle levende organismer har **celler** og **DNA** til fælles, arvet fra det første liv.

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 

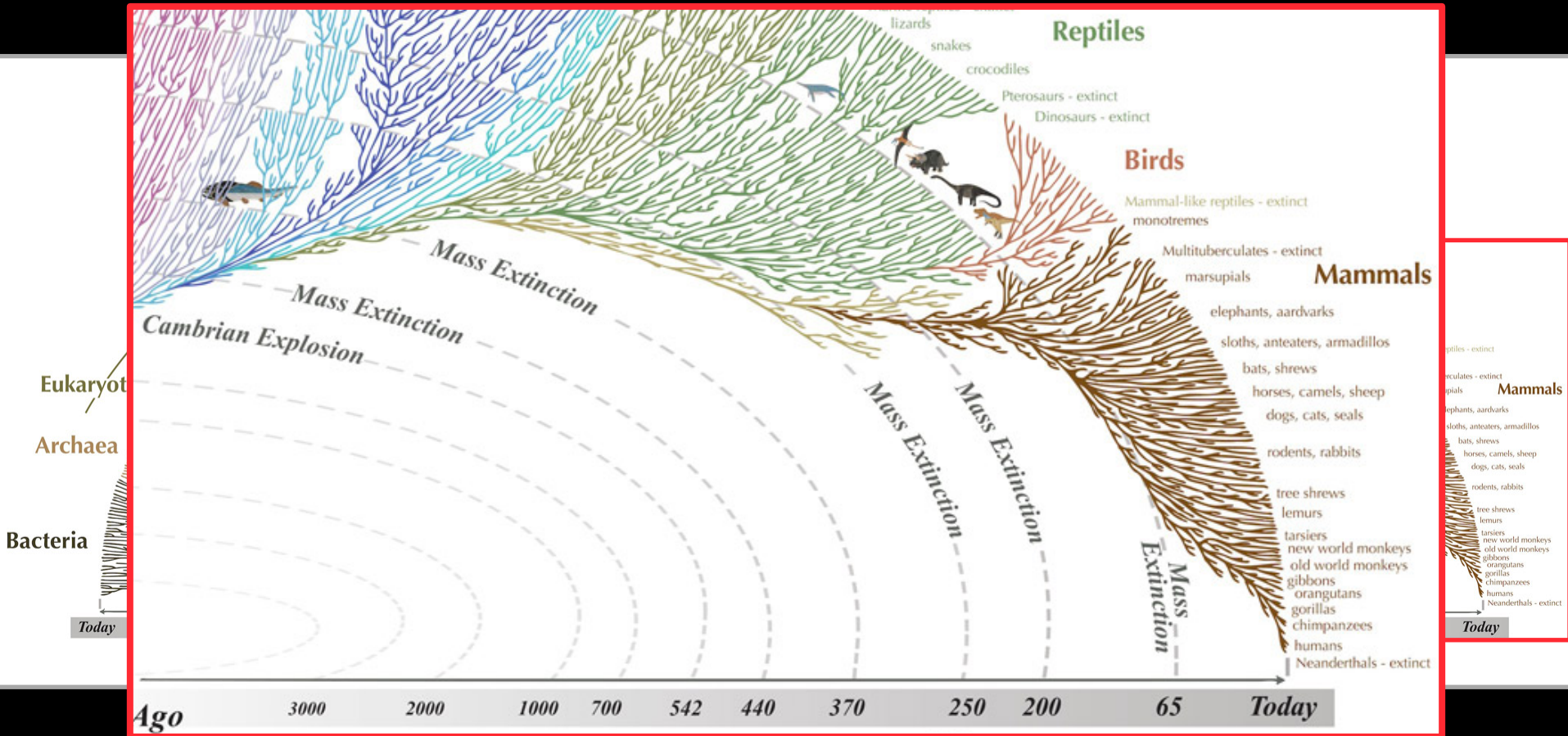
Livets familietræ



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



Livets familietræ



Man estimerer at **99%** af alle dannede arter er uddøde igen

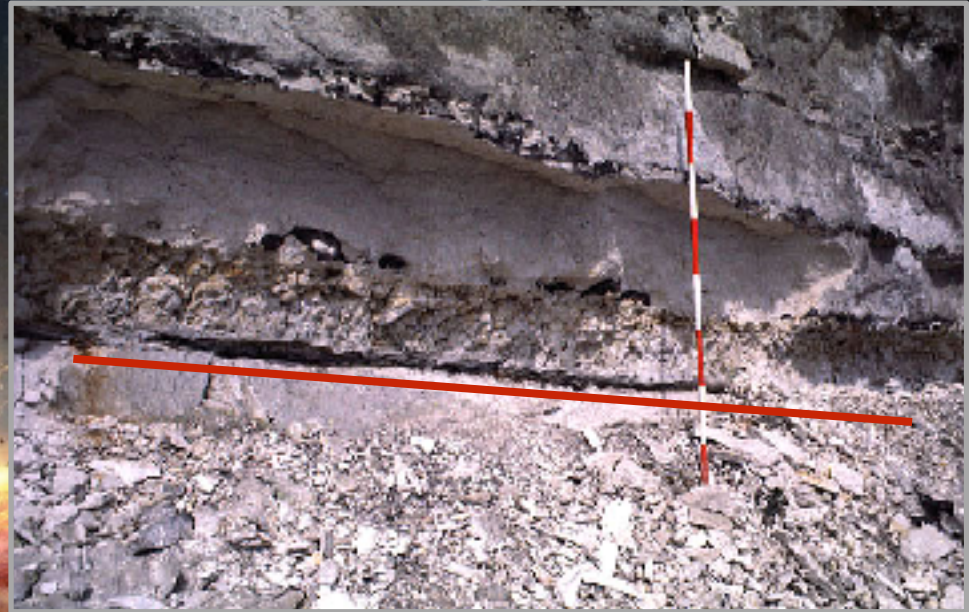
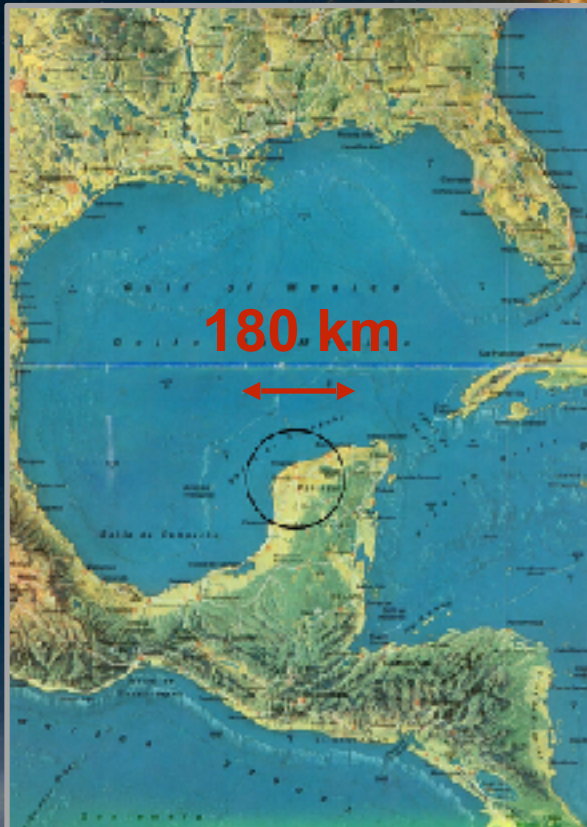
Dinosaurernes uddøen...
...pattedyrenes chance!



Dinosaurernes uddøen... ...pattedyrenes chance!

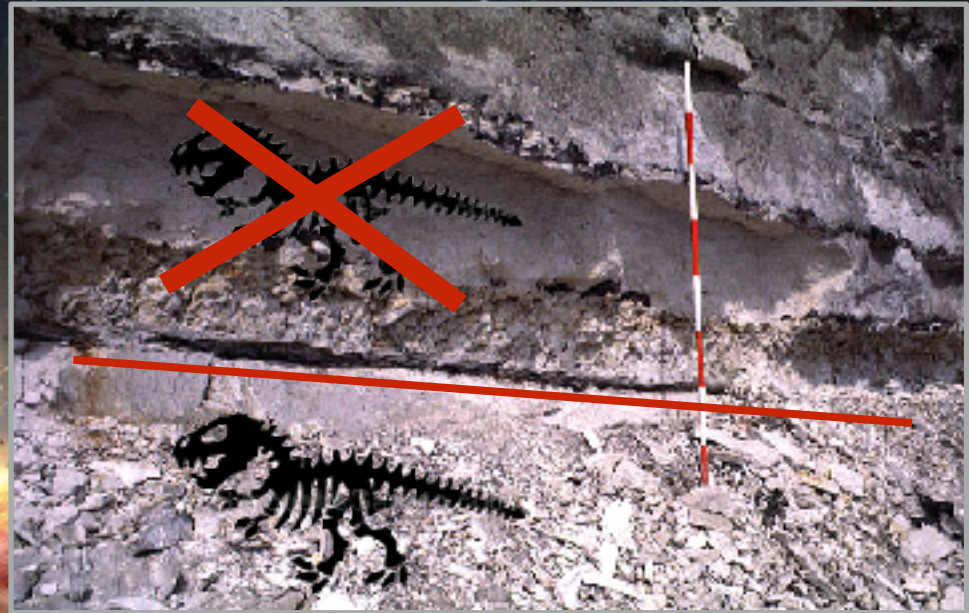
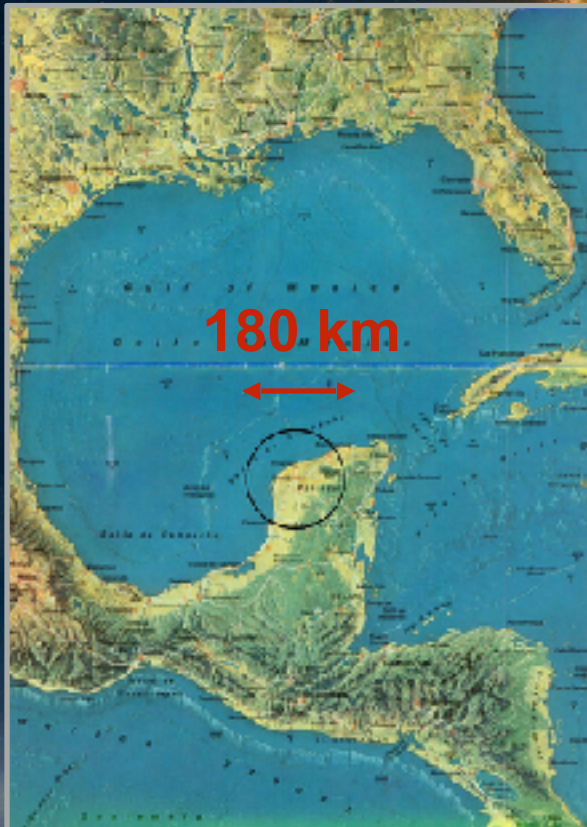


Dinosaurusernes uddøen... ...pattedyrenes chance!



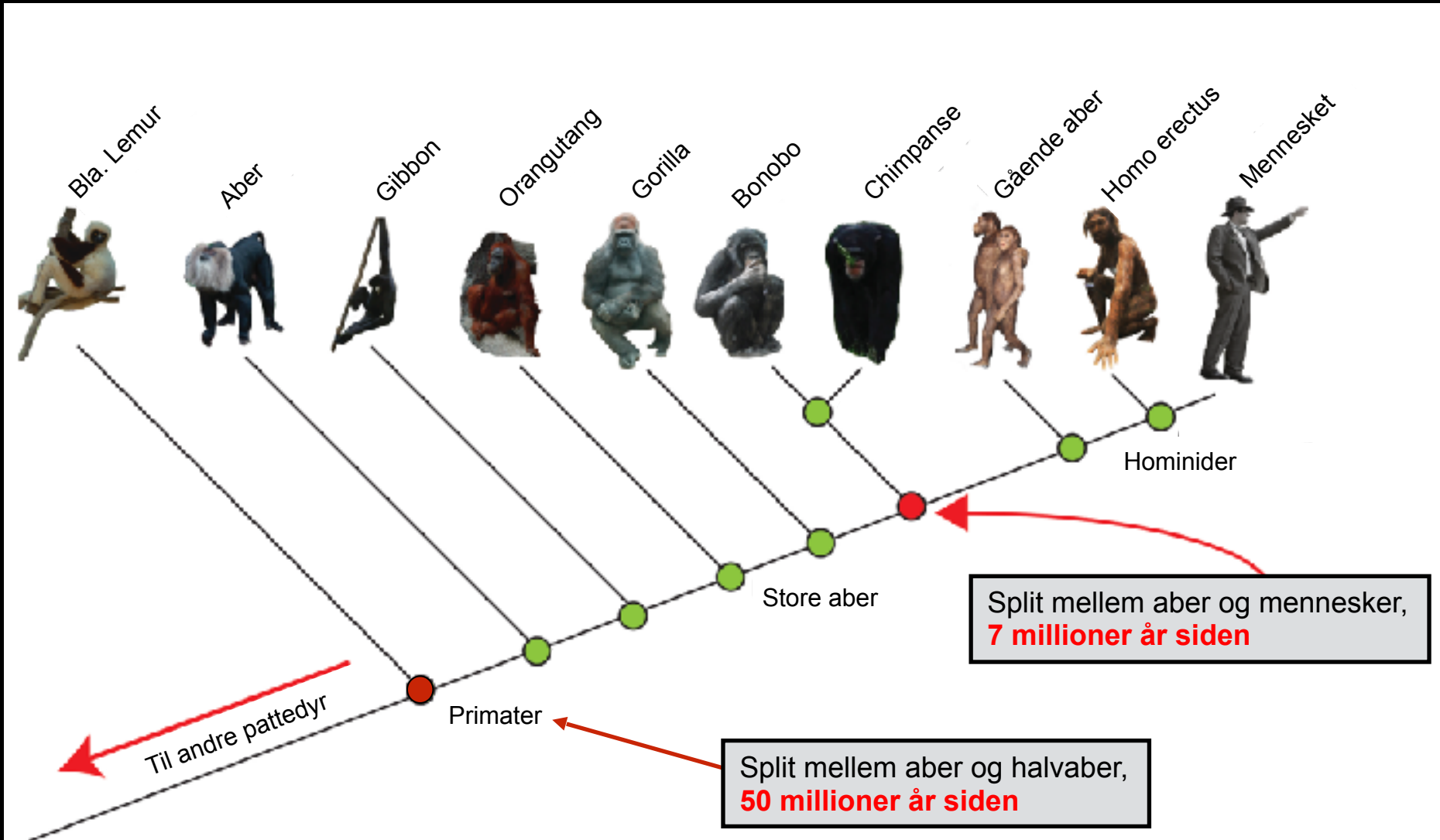
Det sorte lag blev lagt for **65 millioner år siden**.
Indeholder iridium, som astroider har, men
jordens skorpe ikke har.
Det resulterede i 75% af alle arters død.

Dinosaurusernes uddøen... ...pattedyrenes chance!

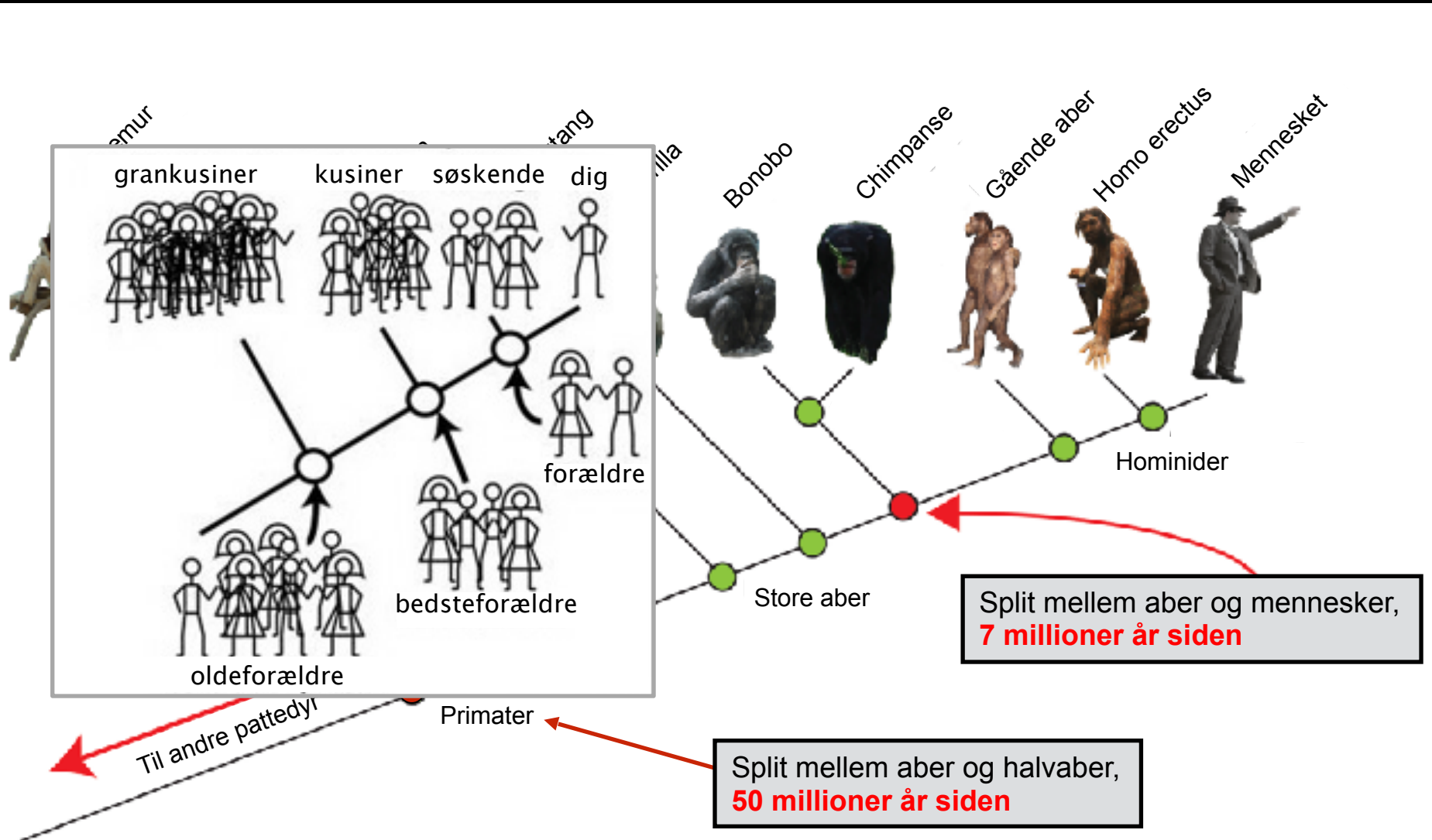


Det sorte lag blev lagt for **65 millioner år siden**.
Indeholder iridium, som astroider har, men
jordens skorpe ikke har.
Det resulterede i 75% af alle arters død.

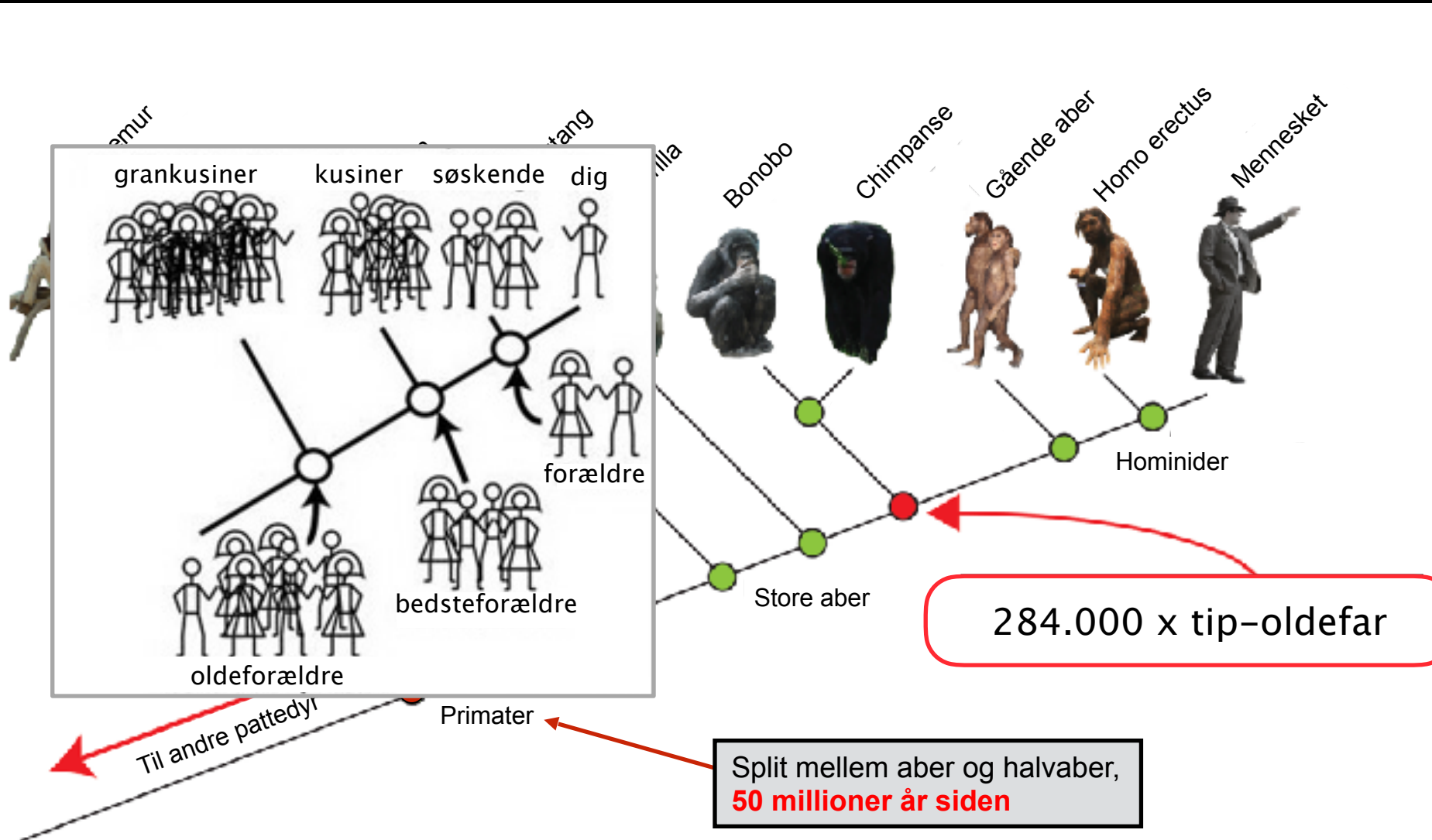
Vores familietræ



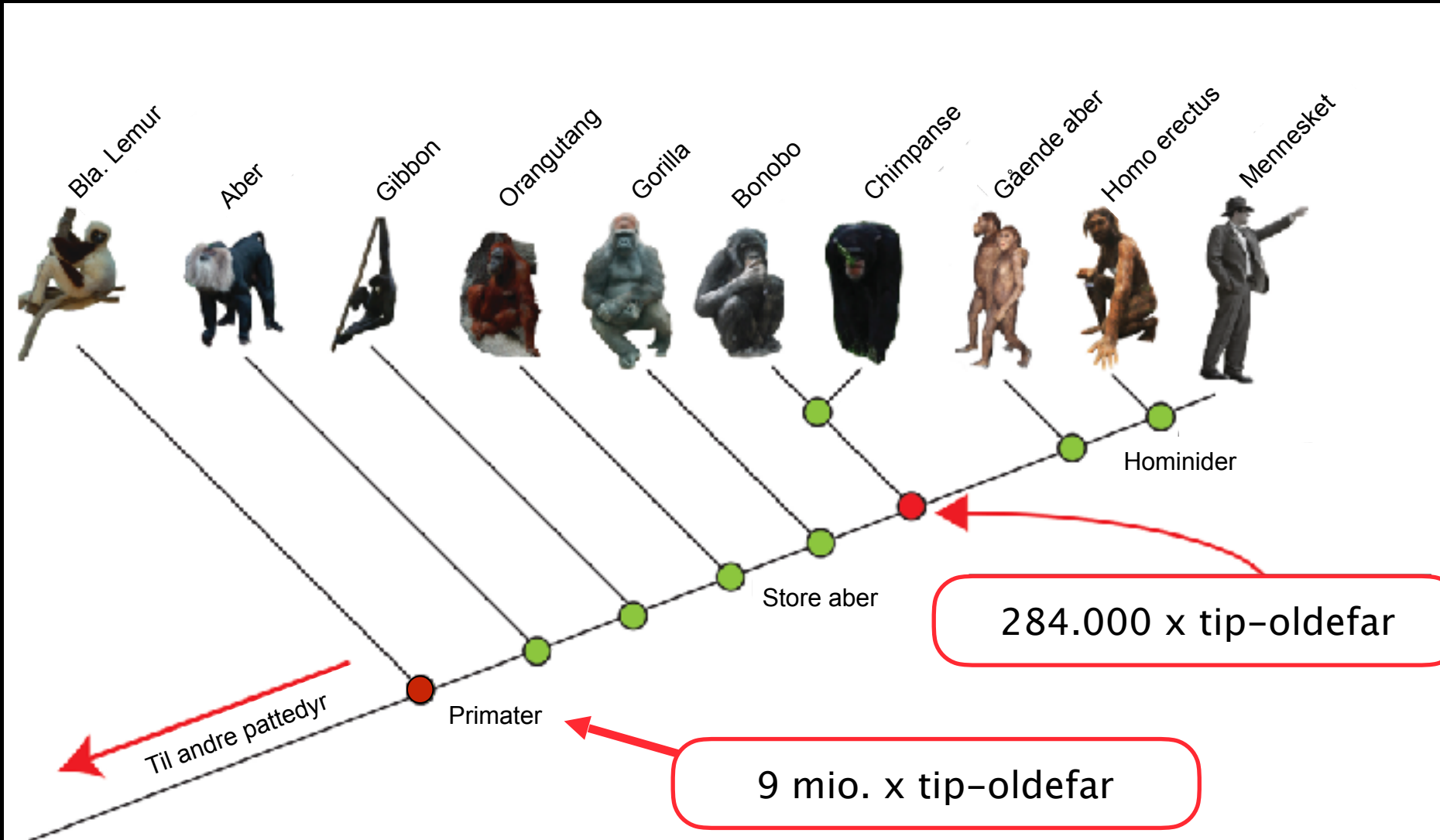
Vores familietræ



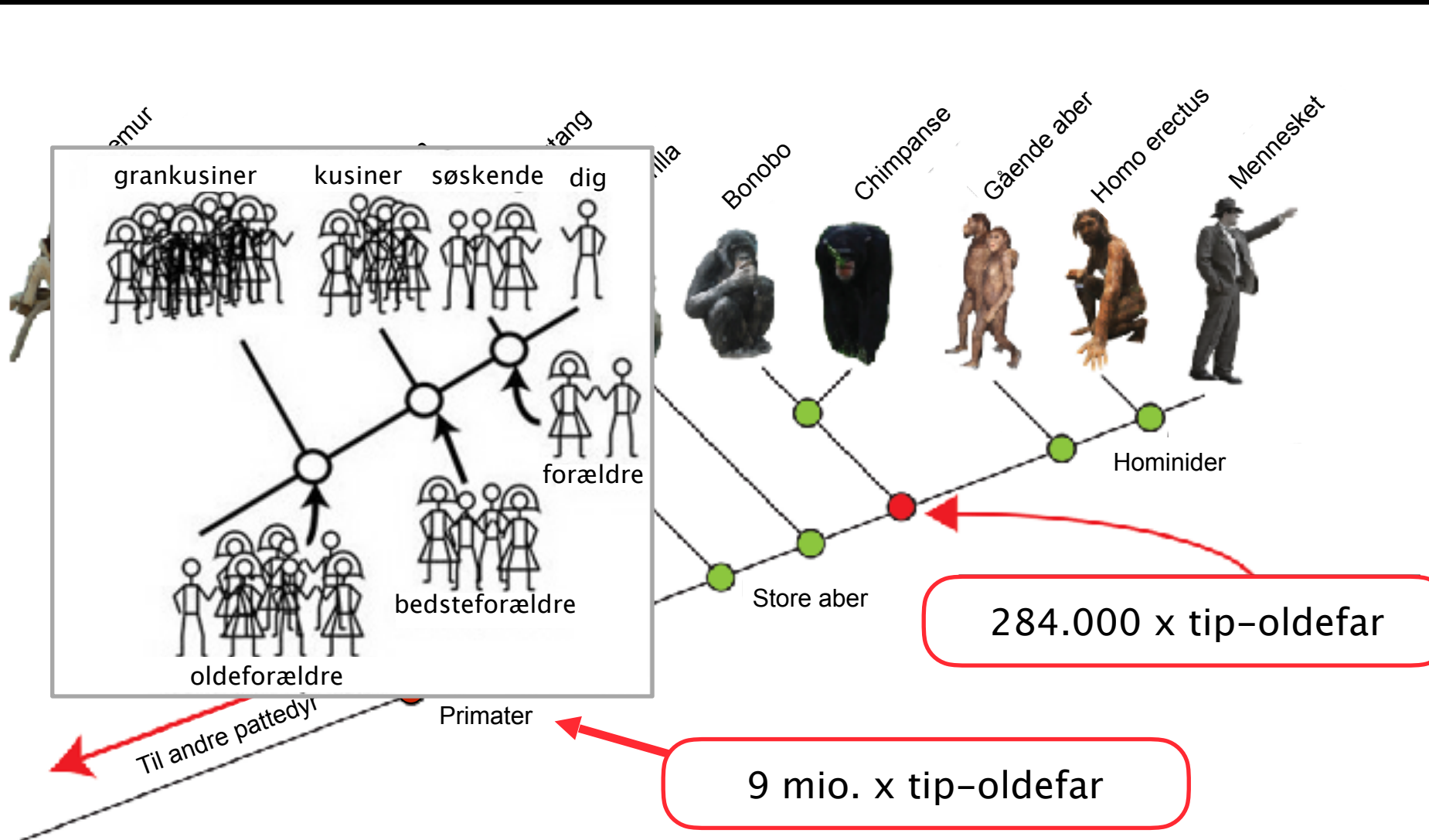
Vores familietræ



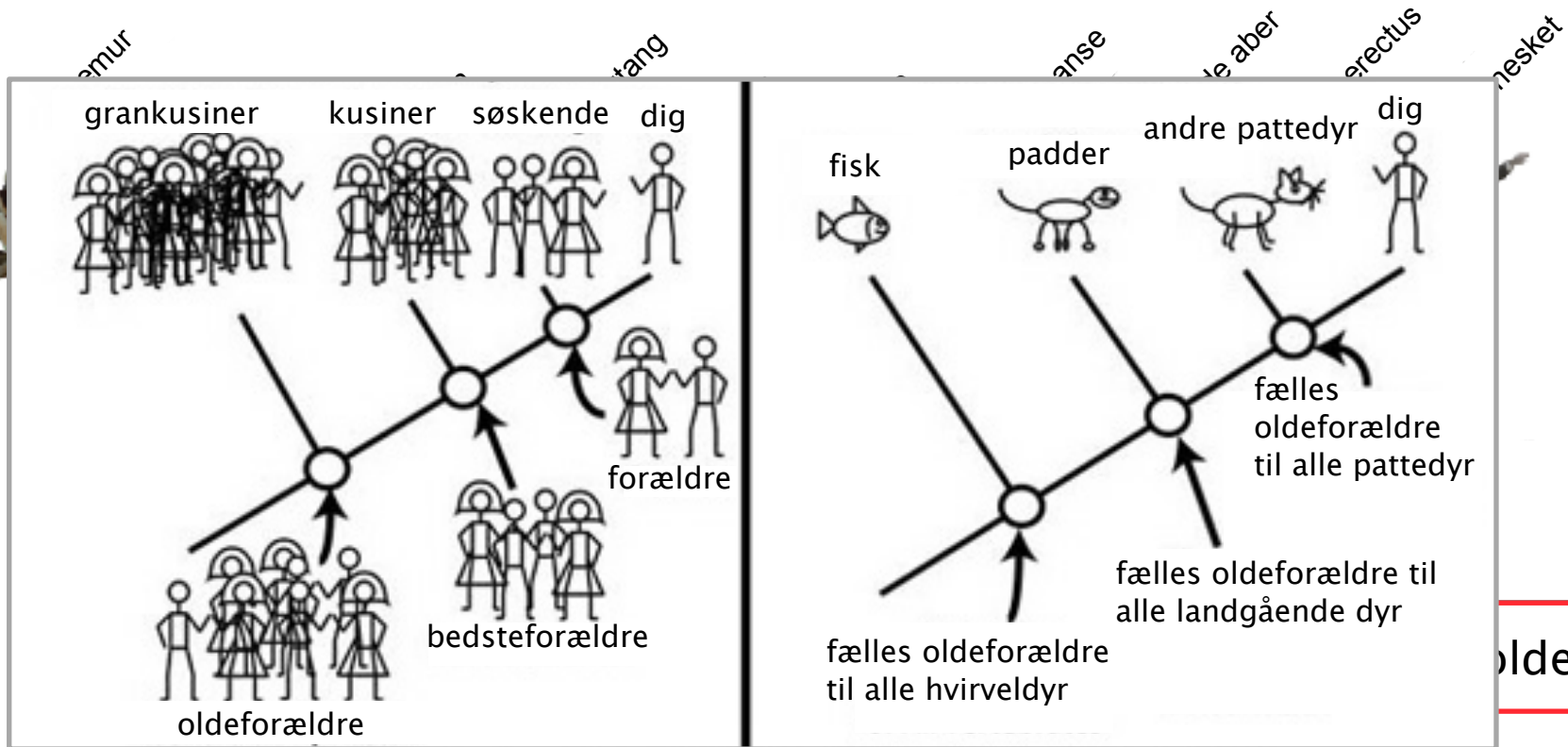
Vores familietræ



Vores familietræ



Vores familietræ

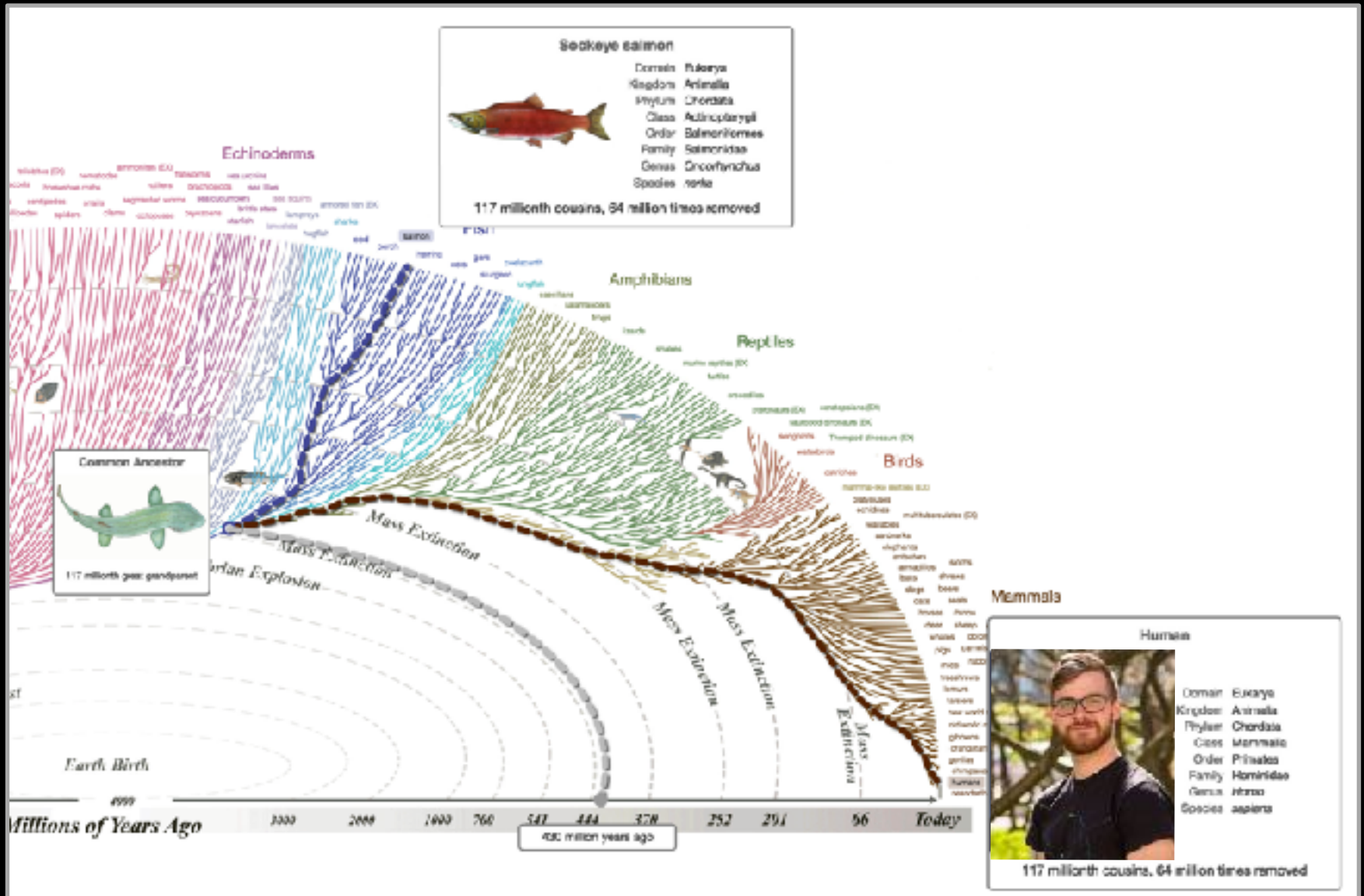


9 mio. x tip-oldefar

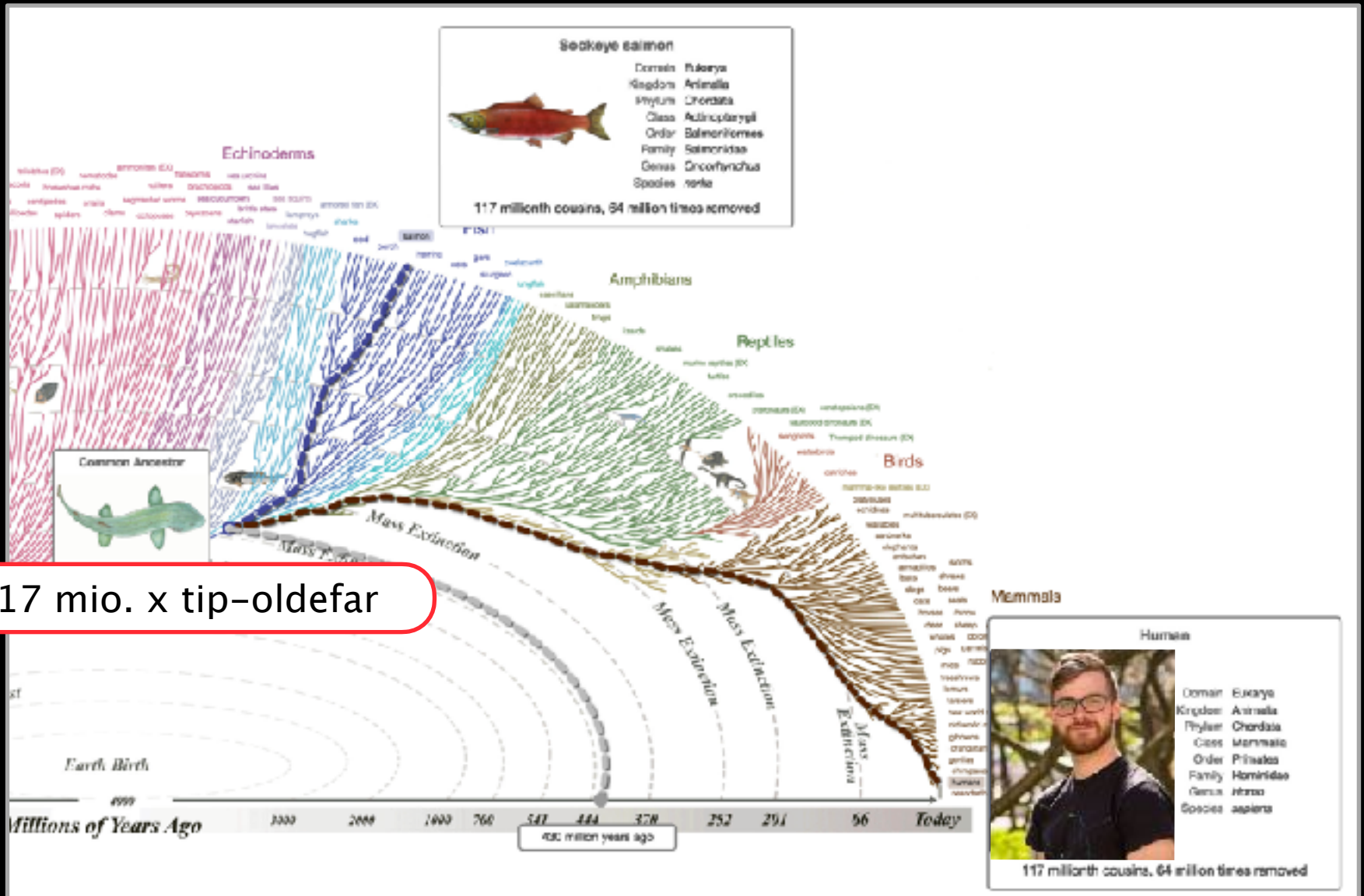
Til andre pattedyr Primater

oldefar

I familie med laksen?

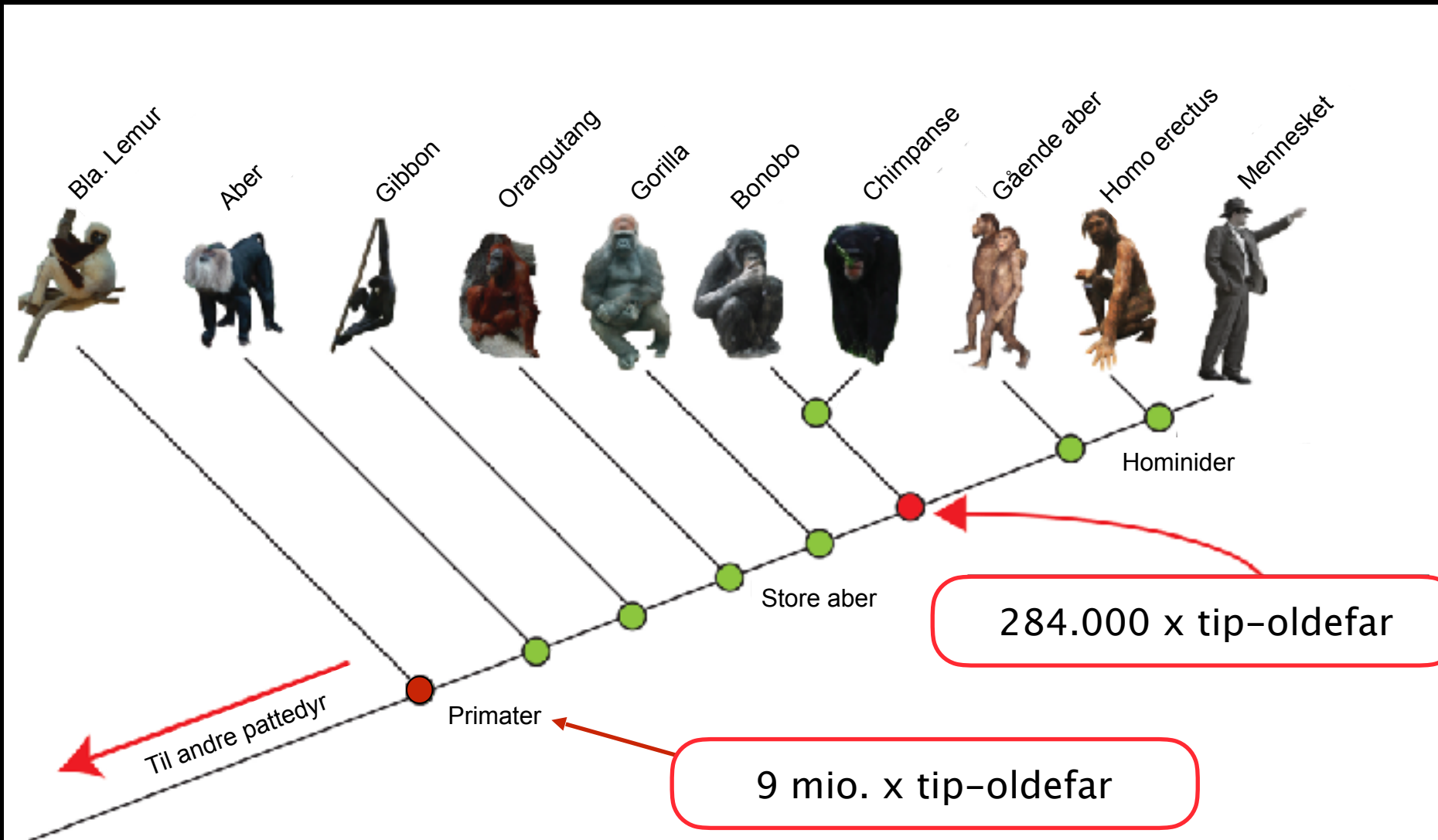


I familie med laksen?



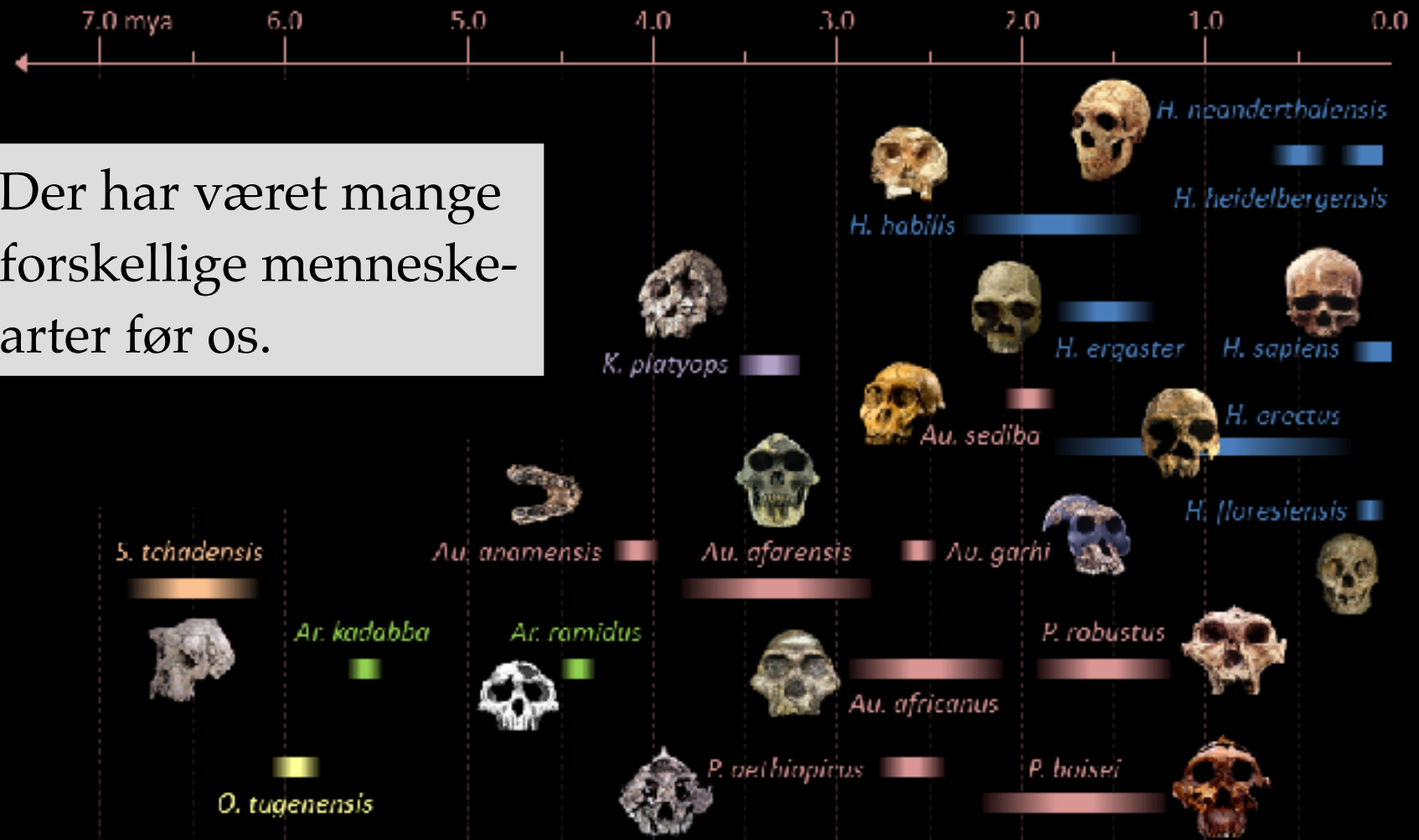
117 mio. x tip-oldefar

Vores familietræ



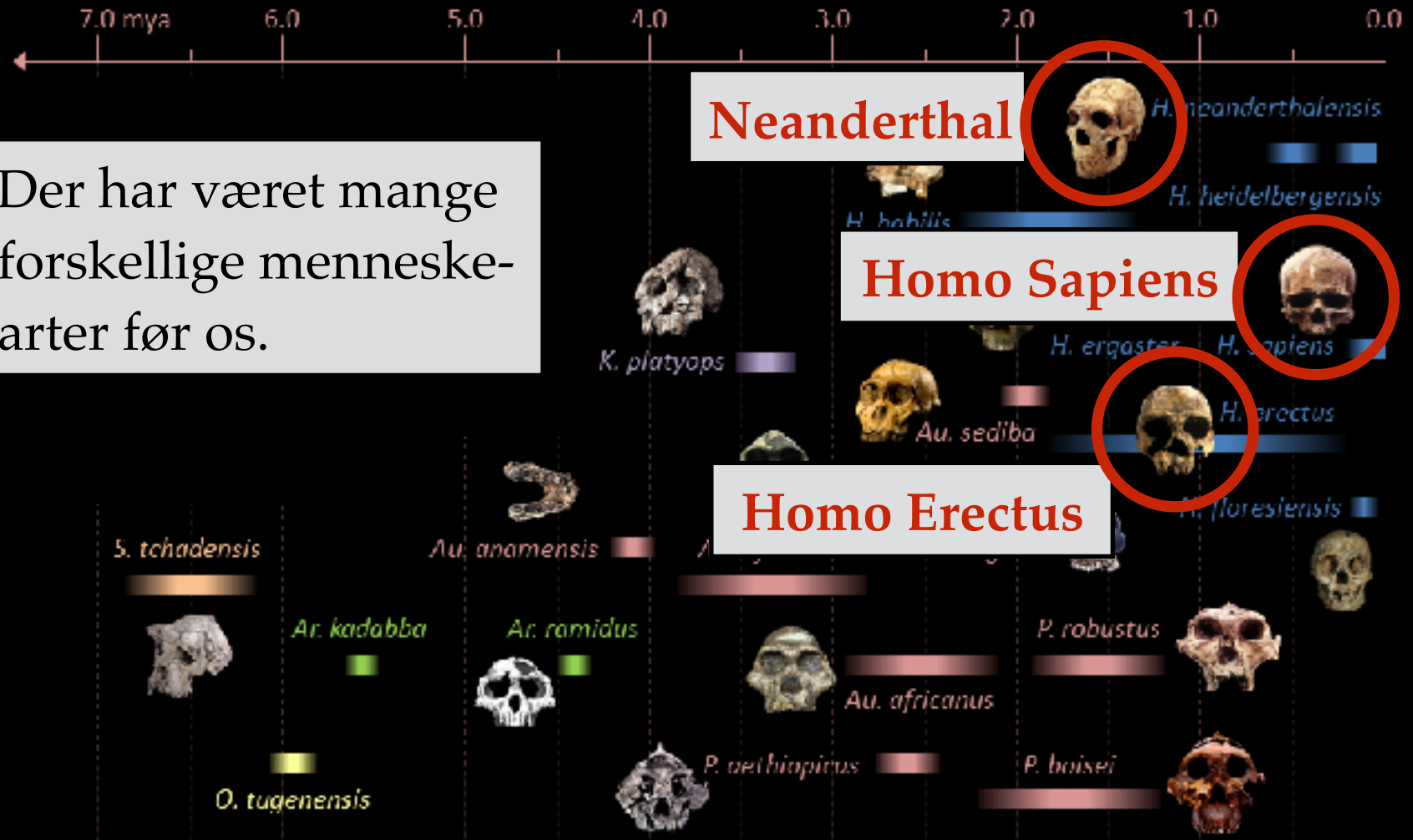
De første hominider

Der har været mange forskellige menneskearter før os.



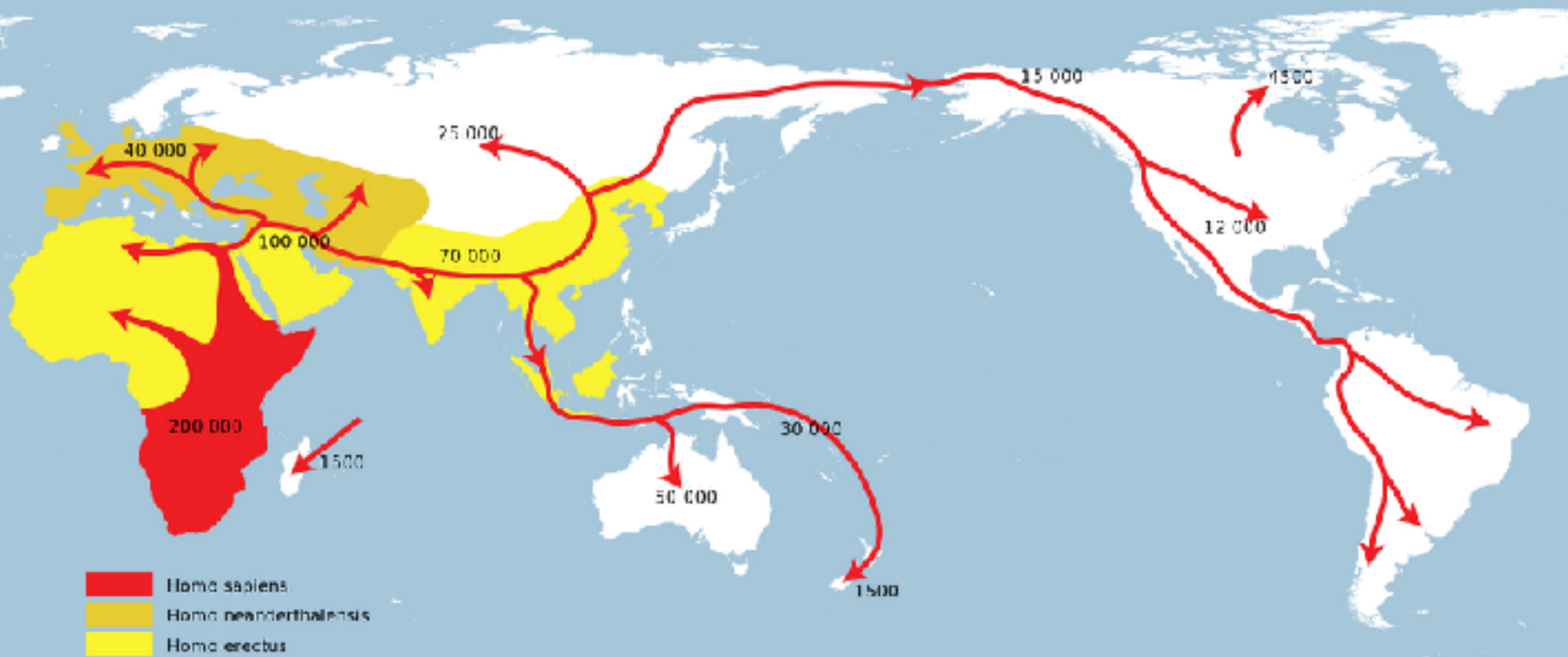
De første hominider

Der har været mange forskellige menneskearter før os.



Moderne menneskes udbredelse

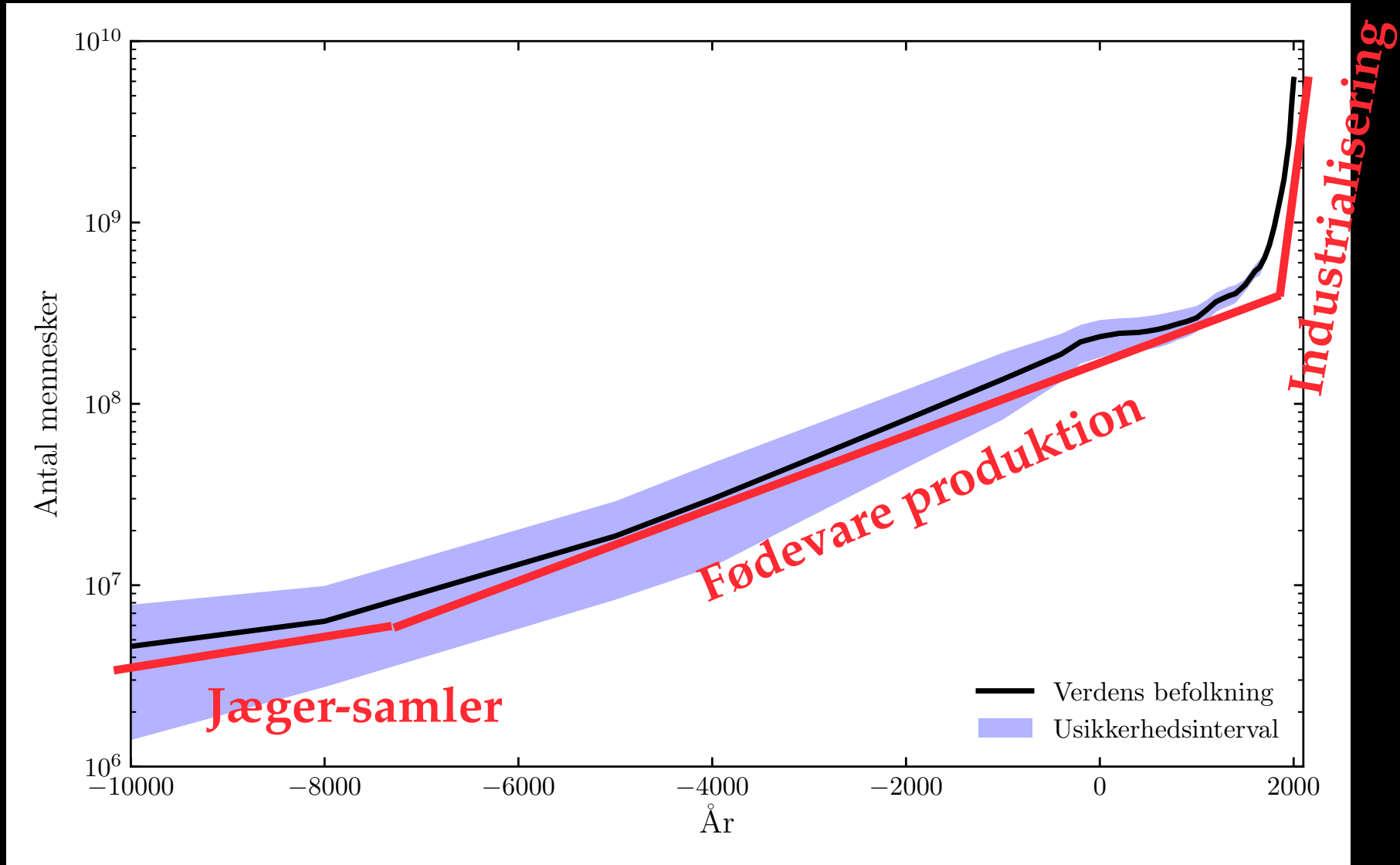
200.000 år siden



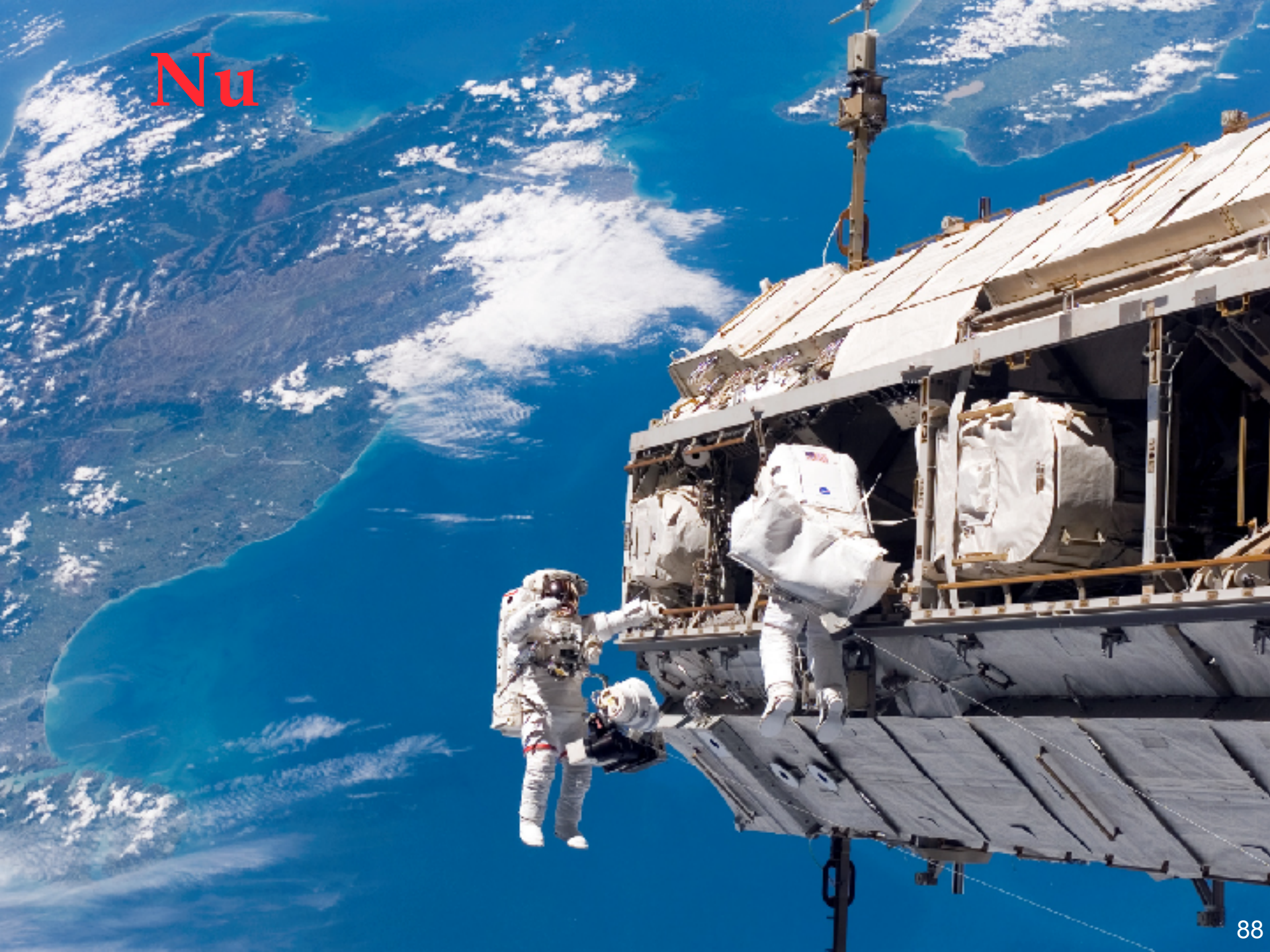
Note: Ovenstående kort er kun en tilnærmelse, og udvikles meget disse år!

Jordens befolkning

og vores samfundsform & opfindelsers indflydelse!



Nu



Mennesket er nået langt

(på geologisk set enormt kort tid)



