

Kratka Istorija Univerzuma

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Kolarac
30 Jun 2017



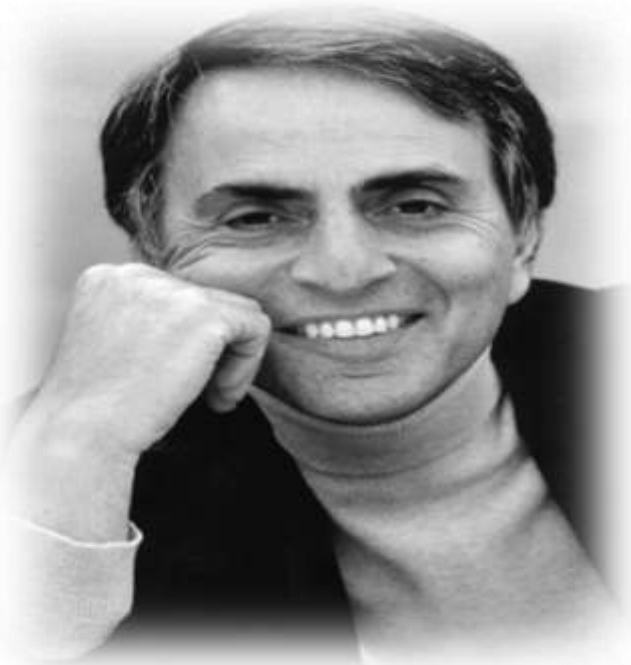
Sadržaj



- **Big Bang**
- **Stvaranje naše galaksije, Sunčevog sistema, planete Zemlje...**
- **Nastanak života na Zemlji**
- **Šta kaže fizika**
- **Evolucija živih organizama**
- **Evolucija ideja i koncepata**
- **Šta nas čeka dalje?**

Kosmicki Kalendar

Starost Univerzuma: 13.7 ± 0.1 milijardi godina



- **Carl Sagan: Smestimo celokupnu istoriju univerzuma u jednu godinu**
- Svaki mesec je od prilike vredan jednu milijardu godina
- U ovoj semi, zivot coveka (70-80) godina traje 0.16 kosmckih sekundi

Kosmicki Kalendar

2001

Starost Univerzuma:
13.7±0.1
Milijardi godina

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
	DEC 31	1	2	3	4	5	6	1
1/01	7	8	9	10	11	12	13	2
JAN	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5

	4	5	6	7	8	9	10	6
FEB	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	29	MAR 1	2	9

12:00:00
1 Januar 2001:
Big Bang

2/01	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
APR	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18

	6	7	8	9	10	11	12	19
MAY	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22

	3	4	5	6	7	8	9	23
JUN	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
3/01	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
JUL	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31

	5	6	7	8	9	10	11	32
AUG	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35

	2	3	4	5	6	7	8	36
SEP	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39

	SEP 30	1	2	3	4	5	6	40
4/01	7	8	9	10	11	12	13	41
OCT	14	15	16	17	18	19	20	42

	21	22	23	24	25	26	27	43
	28	29	30	31	NOV 1	2	3	44
	4	5	6	7	8	9	10	45
	11	12	13	14	15	16	17	46
	18	19	20	21	22	23	24	47
	25	26	27	28	29	30	DEC 1	48

	2	3	4	5	6	7	8	49
DEC	9	10	11	12	13	14	15	50
	16	17	18	19	20	21	22	51
	23	24	25	26	27	28	29	52

12:00:00
1 Januar 2002:
Sadasnji momenat

Sve pocinje sa Big Bang-om



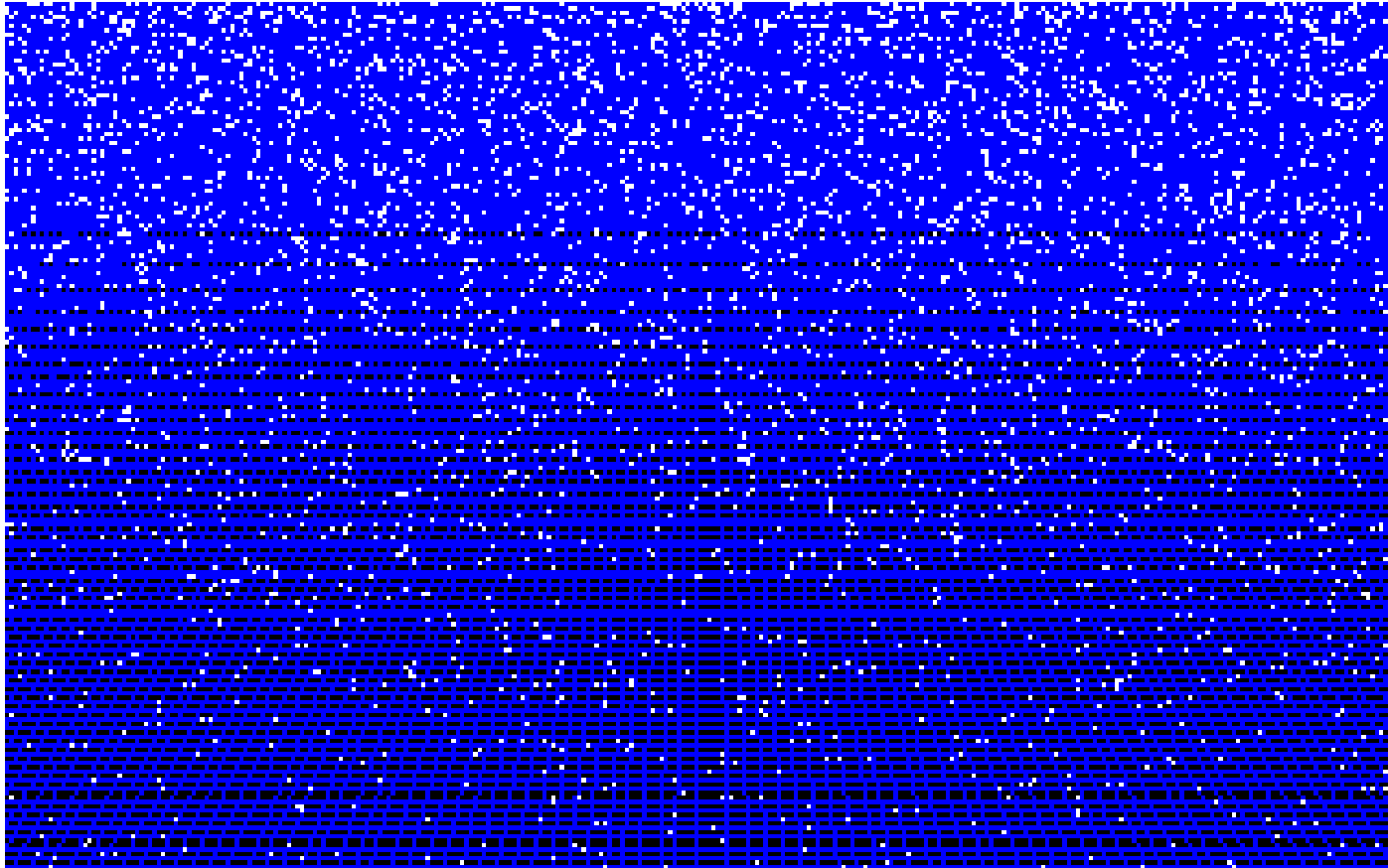
Big Bang



Plazma



- Cestice se kreću brzinom svetlosti
- Strukture ne mogu da se formiraju

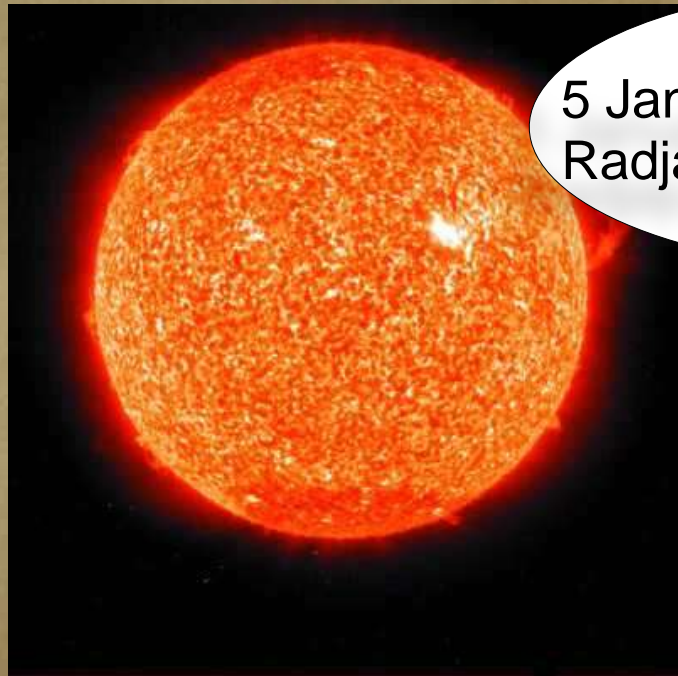


- Univerzum se u medjuvremenu siri
- I istovremeno hladi

Kosmicki Kalendar

2001

Pre 13.5 milijardi godina

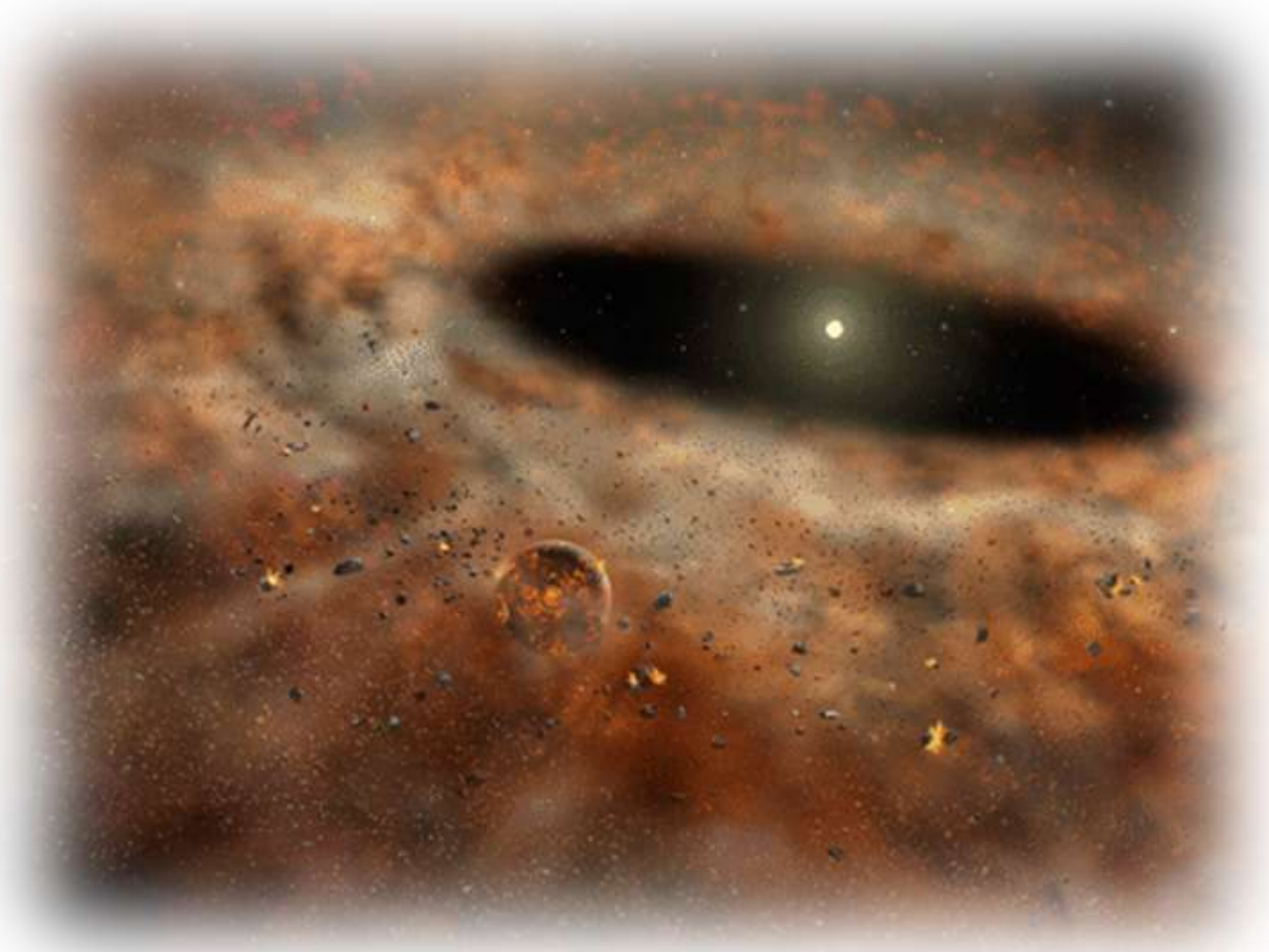


5 Januar:
Radjaju se prve zvezde.

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
	DEC 31	1	2	3	4	5	6	1
1/01	7	8	9	10	11	12	13	2
JAN	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31				5
	4	5	6	7	8	9	10	6
							17	7
								8
								9
								10
								11
								12
								13
2/01	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
APR	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
	6	7	8	9	10	11	12	19
MAY	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
	3	4	5	6	7	8	9	23
JUN	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
3/01	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
JUL	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
	5	6	7	8	9	10	11	32
AUG	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
	2	3	4	5	6	7	8	36
SEP	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
								40
	SEP 30	1	2	3	4	5	6	40
4/01	7	8	9	10	11	12	13	41
OCT	14	15	16	17	18	19	20	42
	21	22	23	24	25	26	27	43
	28	29	30	31	NOV 1	2	3	44
	4	5	6	7	8	9	10	45
NOV	11	12	13	14	15	16	17	46
	18	19	20	21	22	23	24	47
	25	26	27	28	29	30	DEC 1	48
	2	3	4	5	6	7	8	49
DEC	9	10	11	12	13	14	15	50
	16	17	18	19	20	21	22	51
	23	24	25	26	27	28	29	52

Prve Zvezde



Kosmicki Kalendar

2001

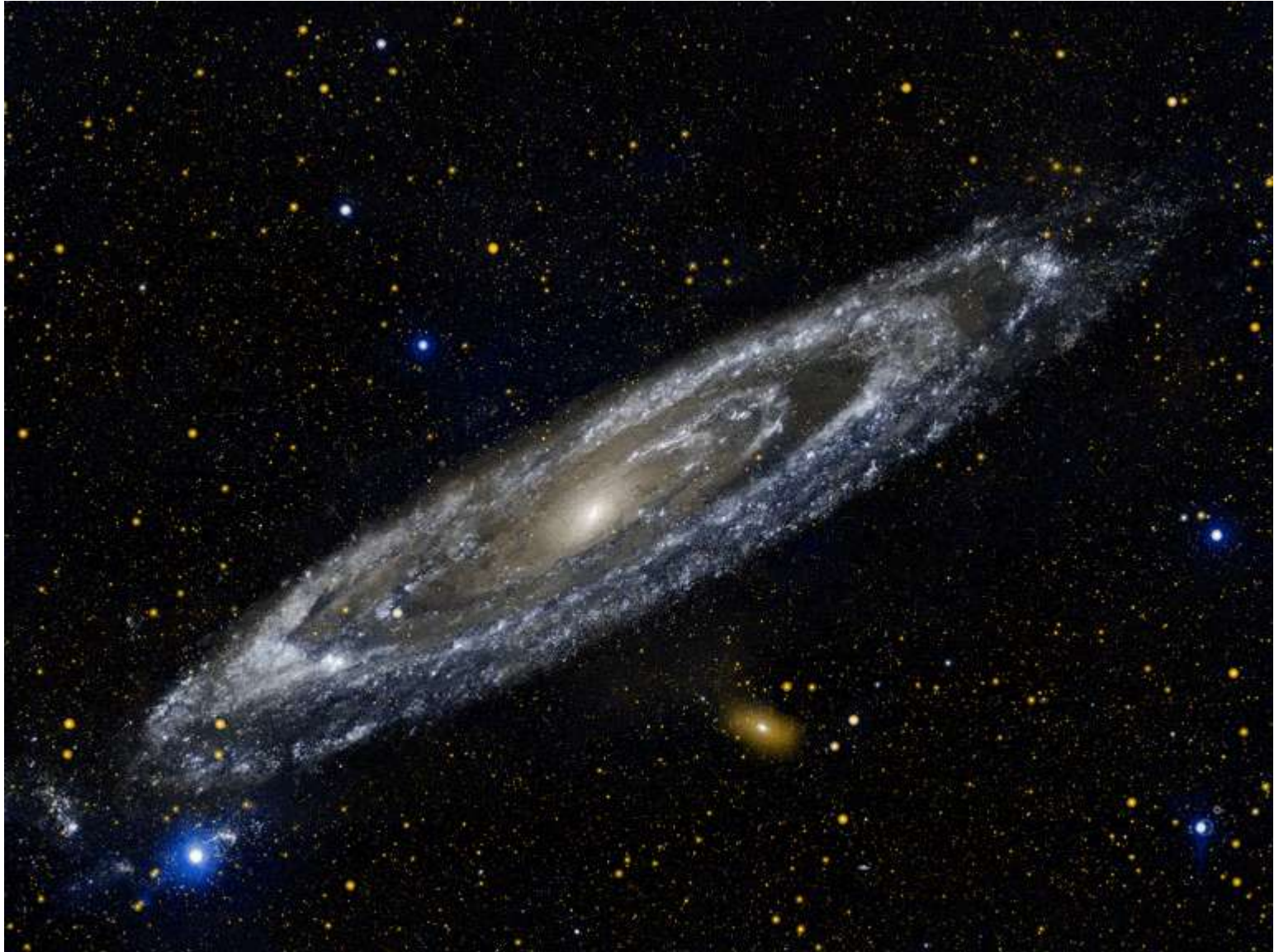
Pre 13 milijardi godina

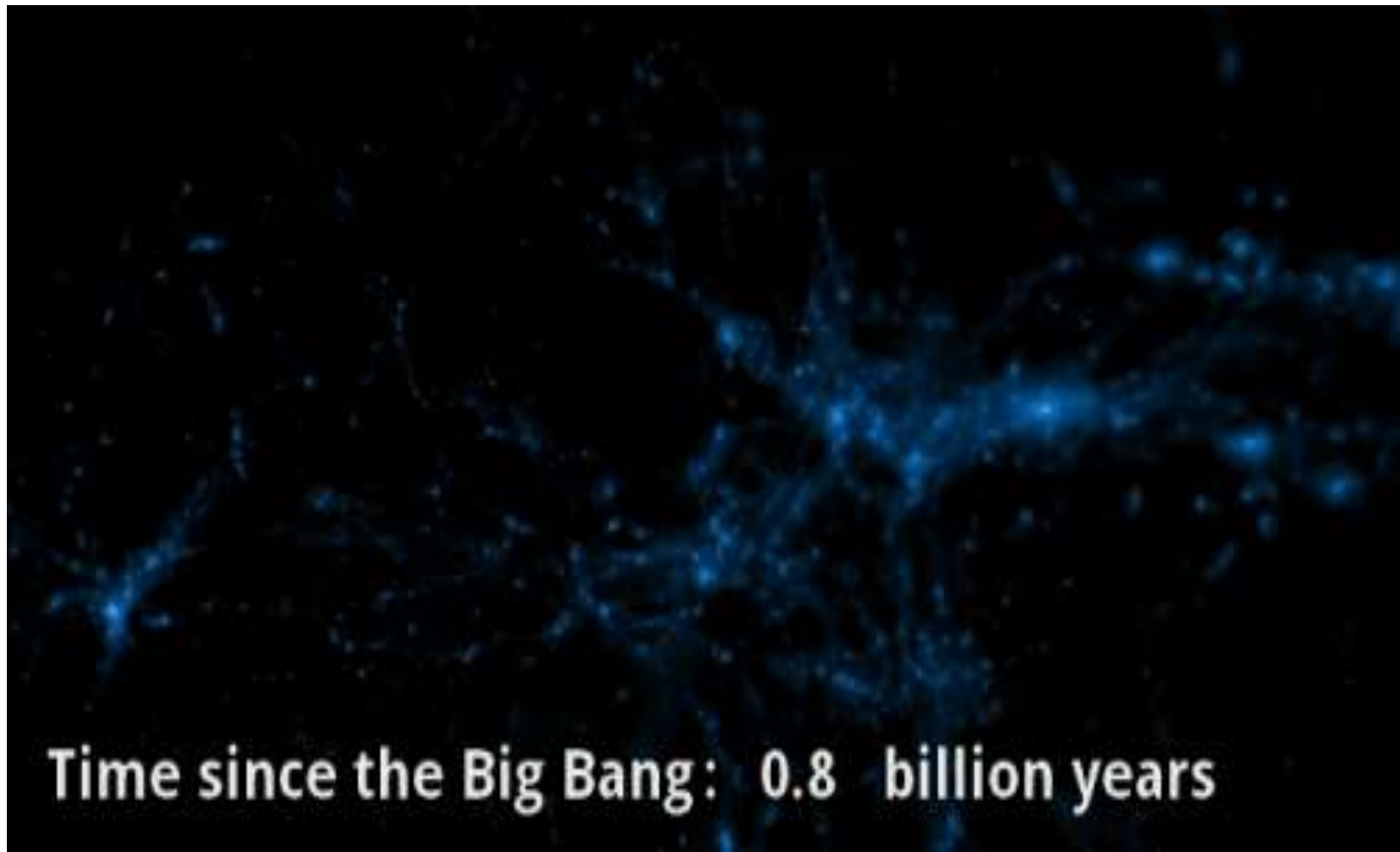


Februar:
Nasa Galaksija se formira

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
1/01 JAN	DEC 31	1	2	3	4	5	6	1
	7	8	9	10	11	12	13	2
	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
FEB	4	5	6	7	8	9	10	6
	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
MAR	4	5	6	7	8	9	10	10
	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
	1	2	3	4	5	6	7	14
MAY	6	7	8	9	10	11	12	19
	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
JUN	3	4	5	6	7	8	9	23
	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
3/01 JUL	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
AUG	5	6	7	8	9	10	11	32
	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
SEP	2	3	4	5	6	7	8	36
	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
4/01 OCT	SEP 30	1	2	3	4	5	6	40
	7	8	9	10	11	12	13	41
	14	15	16	17	18	19	20	42
	21	22	23	24	25	26	27	43
	28	29	30	31	NOV 1	2	3	44
NOV	4	5	6	7	8	9	10	45
	11	12	13	14	15	16	17	46
	18	19	20	21	22	23	24	47
	25	26	27	28	29	30	DEC 1	48
DEC	2	3	4	5	6	7	8	49
	9	10	11	12	13	14	15	50
	16	17	18	19	20	21	22	51
	23	24	25	26	27	28	29	52

Galaksije sadrže stotine milijardi zvezda





Time since the Big Bang: 0.8 billion years

Kosmicki Kalendar

Pre 4.5 milijarde godina



	SUN	MON	TUE	WED	THU		
		DEC 31	1	2	3	4	
1/01		7	8	9	10	11	28
JAN		14	15	16	17	18	29
		21	22	23	24	25	30
		28	29	30	31	FEB 1	31
		4	5	6	7	8	32
FEB		11	12	13	14	15	33
		18	19	20	21	22	34
		25	26	27	28	MAR 1	35
		4	5	6	7	8	36
MAR		11	12	13	14	15	37
		18	19	20	21	22	38
		25	26	27	28	29	39
		1	2	3	4	5	40
2/01		8	9	10	11	12	41
APR		15	16	17	18	19	42
		22	23	24	25	26	43
		29	30	MAY 1	2	3	44
		6	7	8	9	10	45
MAY		13	14	15	16	17	46
		20	21	22	23	24	47
		27	28	29	30	31	48
		3	4	5	6	7	49
JUN		10	11	12	13	14	50
		17	18	19	20	21	51
		24	25	26	27	28	52
		2	3	4	5	6	49
		9	10	11	12	13	50
		16	17	18	19	20	51
		23	24	25	26	27	52

31. Avgust:
SunceV Sistem se formira

7. Septembar:
Zemlja se formira



Suncev system je nastao gravitacionim kolapsom gasa u jednom delu nase galaksije


**WE BELIEVE THAT THERE WAS A VERY LARGE
STAR THAT EXPLODED AND CREATED A VERY
LARGE CLOUD OF DUST GAS CALLED A**



NEBULA



- Mi smo napravljeni od jednom već koriscenog materijala
- Od ostataka zvezde koja je eksplodirala



**UNDER GRAVITY, THIS CLOUD COLLAPSED
AND IS THOUGHT TO HAVE FORMED THE
SOLAR SYSTEM**

4.6 BILLION YEARS AGO



AT ONE POINT, THE SUN HAD ACHIEVED ENOUGH MASS TO START NUCLEAR FUSION AND BLASTED MOST OF THE OTHER GASES OUT WITH ITS SOLAR WIND.

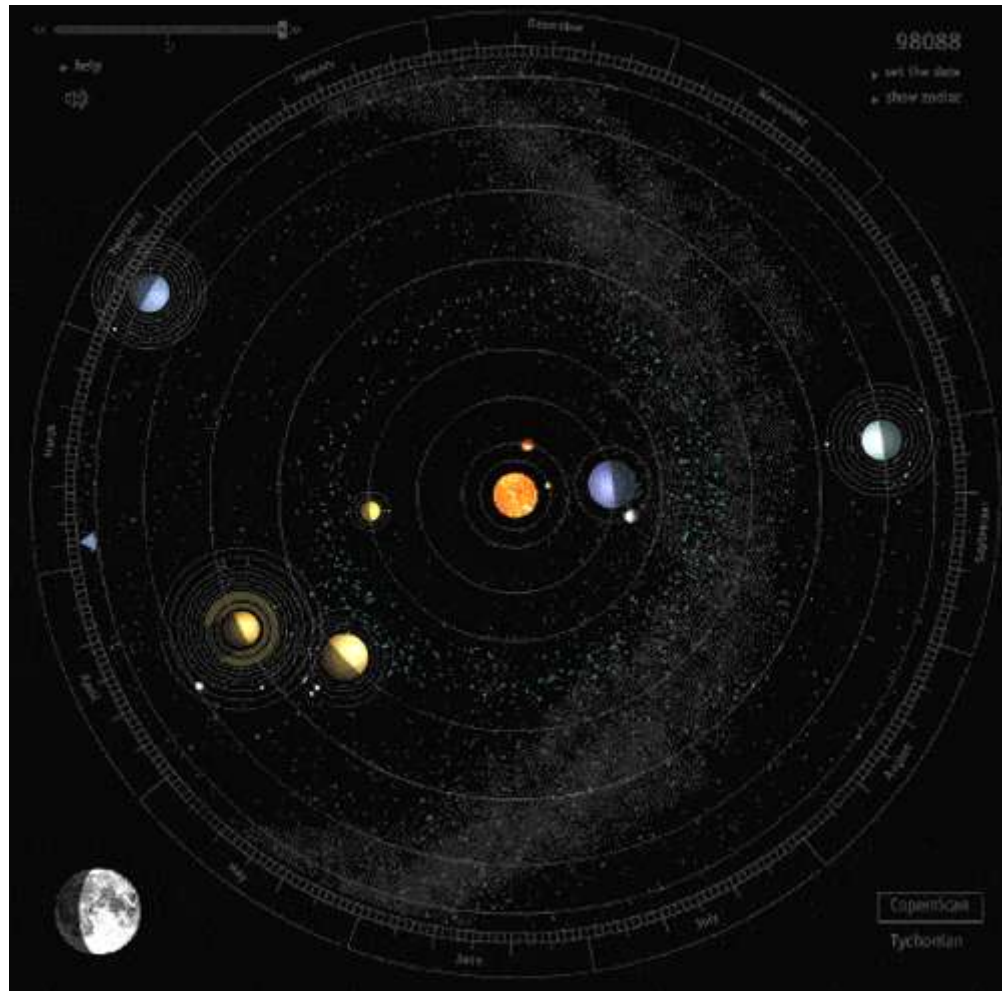


**AT THE SAME
TIME THAT THE
SUN WAS
FORMING, OTHER
ROCKS AND
GASSES WERE
CONDENSING
AND COLLIDING
TOGETHER TO
FORM THE
PLANETS**

**OVER COUNTLESS COLLISIONS,
LARGER PLANETS FORMED FROM
SMALLER MATERIAL.**



NATIONAL GEOGRAPHIC

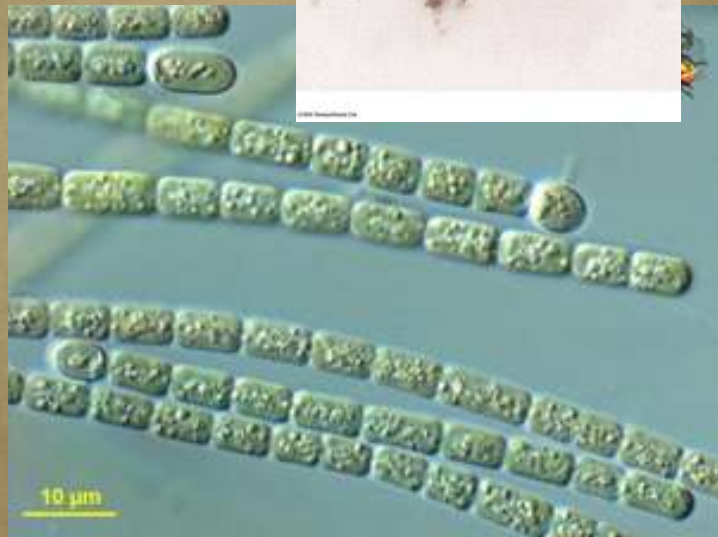


I tako je pre 4.5 milijarde godina nastala Zemlja



Kosmicki Kalendar

2001



Pre 3.5 milijarde godina

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.		WED	THU	FRI	SAT	Week No.
		DEC 31	1	2	3	4	5	6	1					27
1/01		7	8	9	10	11	12	13	2					28
JAN		14	15	16	17	18	19	20	3					29
		21	22	23	24	25	26	27	4					30
		28	29	30	31	FEB 1	2	3	5					31
		4	5	6	7	8	9	10	6					
FEB		11	12	13	14	15	16	17	7					
		18	19	20	21	22	23	24	8					
		25	26	27	28	MAR 1	2	3	9					
		4	5	6	7	8	9	10	10					
MAR		11	12	13	14	15	16	17	11					
		18	19	20	21	22	23	24	12					
		25	26	27	28	29	30	31	13					
2/01		1	2	3	4	5	6	7	14					
		8	9	10	11	12	13	14	15					
APR		15	16	17	18	19	20	21	16					
		22	23	24	25	26	27	28	17					
		29	30	MAY 1	2	3	4	5	18					
		6	7	8	9	10	11	12	19					
MAY		13	14	15	16	17	18	19	20					
		20	21	22	23	24	25	26	21					
		27	28	29	30	31	JUN 1	2	22					
		3	4	5	6	7	8	9	23					
JUN		10	11	12	13	14	15	16	24					
		17	18	19	20	21	22	23	25					
		24	25	26	27	28	29	30	26					
		5	6	7	8	9	10	11						
		12	13	14	15	16	17	18						
AUG		19	20	21	22	23	24	25						
		26	27	28	29	30	31	SEP 1						
		2	3	4	5	6	7	8						
SEP		9	10	11	12	13	14	15						
		16	17	18	19	20	21	22						
		23	24	25	26	27	28	29						
3/01		1	2	3	4	5	6	7						
		8	9	10	11	12	13	14						
APR		15	16	17	18	19	20	21						
		22	23	24	25	26	27	28						
		29	30	SEP 30	1	2	3	4						
4/01		7	8	9	10	11	12	13						
OCT		14	15	16	17	18	19	20						
		21	22	23	24	25	26	27						
		28	29	30	31	1	2	3						
		4	5	6	7	8	9	10						
		11	12	13	14	15	16	17						
AUG		18	19	20	21	22	23	24						
		25	26	27	28	29	30	31						
		2	3	4	5	6	7	8						
SEP		9	10	11	12	13	14	15						
		16	17	18	19	20	21	22						
		23	24	25	26	27	28	29						
5/01		2	3	4	5	6	7	8						
		9	10	11	12	13	14	15						
DEC		16	17	18	19	20	21	22						
		23	24	25	26	27	28	29						

Polovina Septembra:
Nastaje zivot na Zemlji

29. Septembra:
Najstariji fosili

Zivot



- Sta je Zivot?
- Zivi organizmi imaju sposobnost da menjaju okolinu

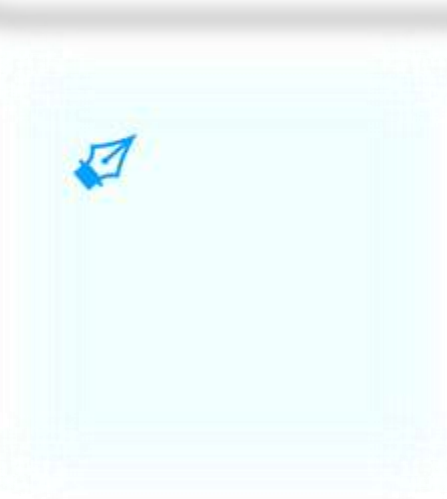
• Ali to nije dovoljno

- Stena koja je kotrlja sa brda takodje menja okolinu
- Vetar menja okolinu
- Kisa menja okolinu



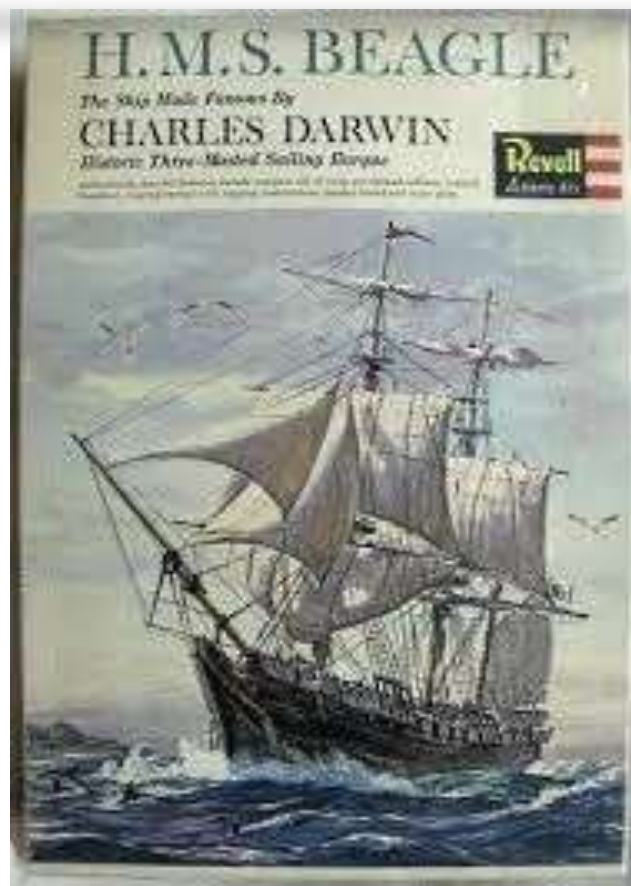
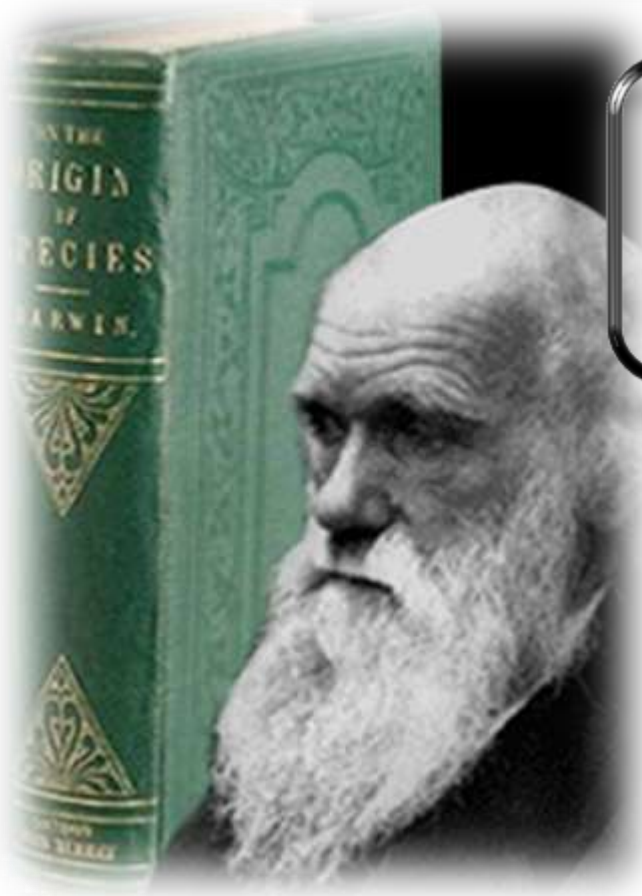
Zivot

- Zivi organizam replicira samog sebe!
replicira
replicira
replicira
replicira
replicira
replicira



Charles Darwin (1809 - 1882)

Biolog na brodu *H.M.S. Beagle*
Ekspedicija je trajala 5 godina
1831-1836.

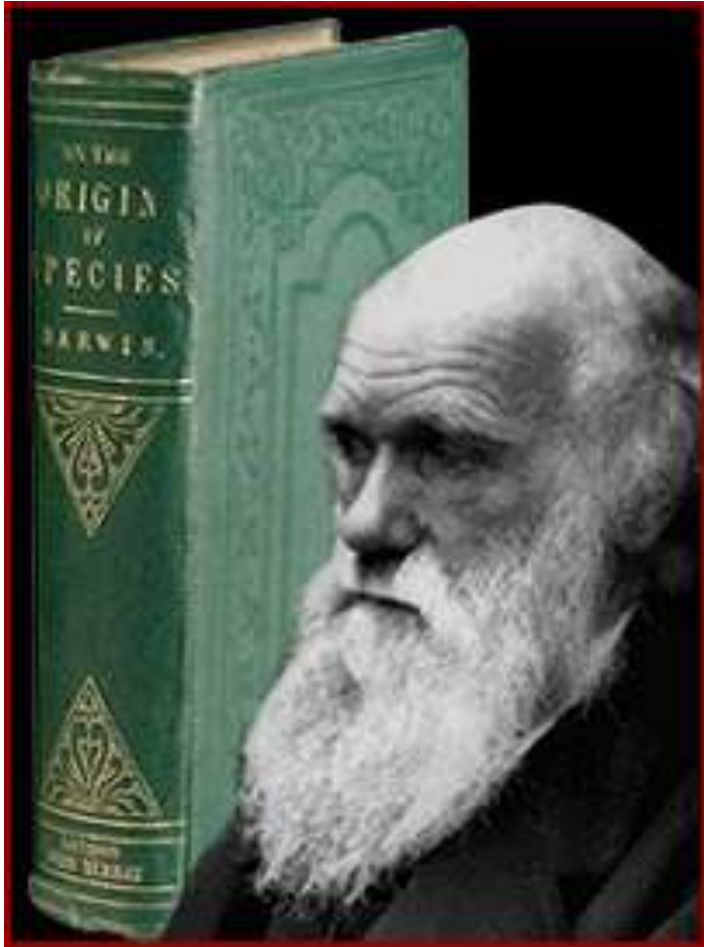


Odlomak iz dnevnika Charles-a Darwin-a

“I wonder if it is possible for the mind of man to conceive anything more degradingly offensive than the condition of us 150 men, shut up in this wooden box, being watered with hot water, as we are now. . . It's too hot to sleep, and my sole amusement consists in watching the cockroaches, which are in a state of intense excitement and happiness.”

-- Darwin on shipboard life

Charles Darwin (1809 - 1882)



Na eskpediciji dobija tropsku bolest koja ga mucu sve do kraja zivota

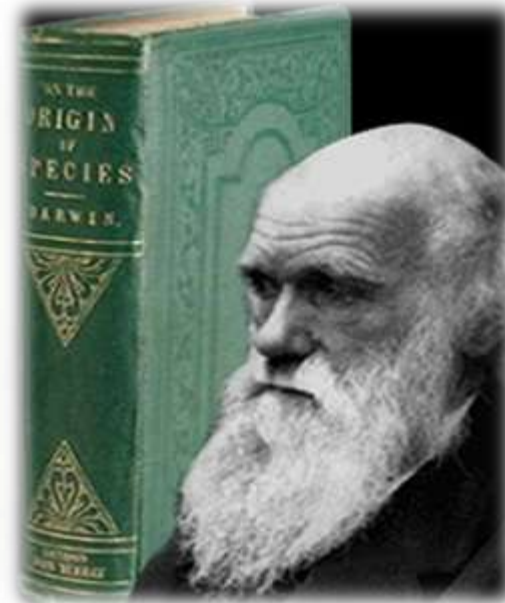
1859 publikuje knjigu
“On the Origin of Species”

U njoj predlaze teoriju po kojoj zivot evoluiru postujuci zakon prirodne selekcije

T.H. Huxley primenjuje prirodnu selekciju na ljudsku evoluciju:
Evidence on Man's Place in Nature (1863).

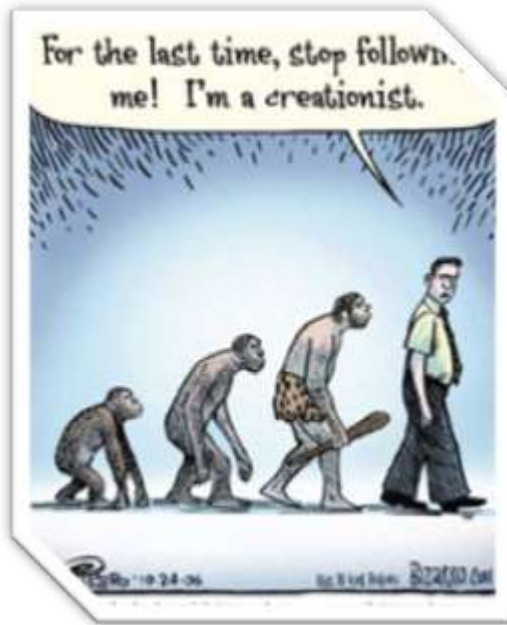


Prirodna selekcija u tri cina



1. Stvari koje mogu da se repliciraju one se repliciraju
2. Stvari koje se repliciraju efikasnije postaju brojnije od stvari koje se repliciraju manje efikasno
3. Rivalitet uvodi selekciju (manje sposobne vrste izumiru)

Starost Zemlje kao problem



Evoluciji su potrebne 100-ine miliona godina za znacajnije promene

Darwin smatrao da je najveći problem za njegovu teoriju činjenica da je Zemlja stara samo 40 000 – nekoliko miliona godina

Danas znamo da je Zemlja stara 4.5 milijarde godina

Reproduktivna Prednost

- Brzina reprodukcije
- Duzi reproduktivni period
- Sposobnost potomstva da prezivi



- Privlacnost suprotnom polu

- Sposobnost za prilagodjavanje promeni zivotne sredine

-

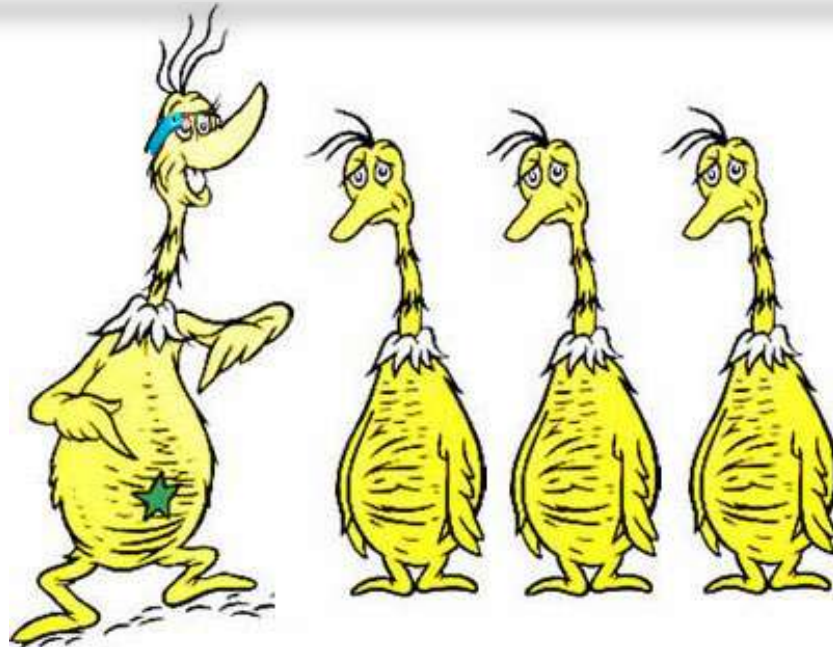


Privlačnost suprotnom polu

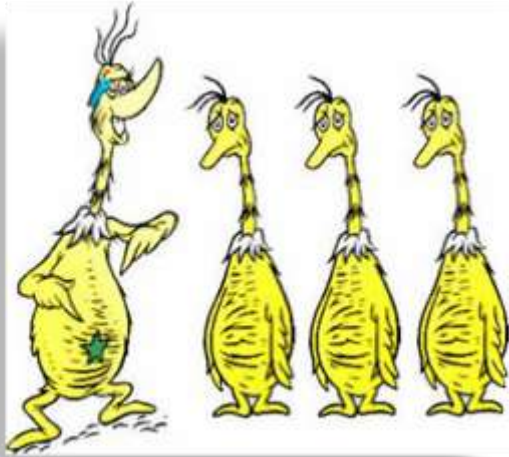
U pripovesti Dr. Seuss-a pod naslovom “Star-belly Sneetches”, na jednom ostrvu zive stvorenja zvana Sneetches

Sneetches sa zvezdom na stomaku su privlacniji suprotnom polu i imaju 0.1% bolje sanse za reprodukciju.

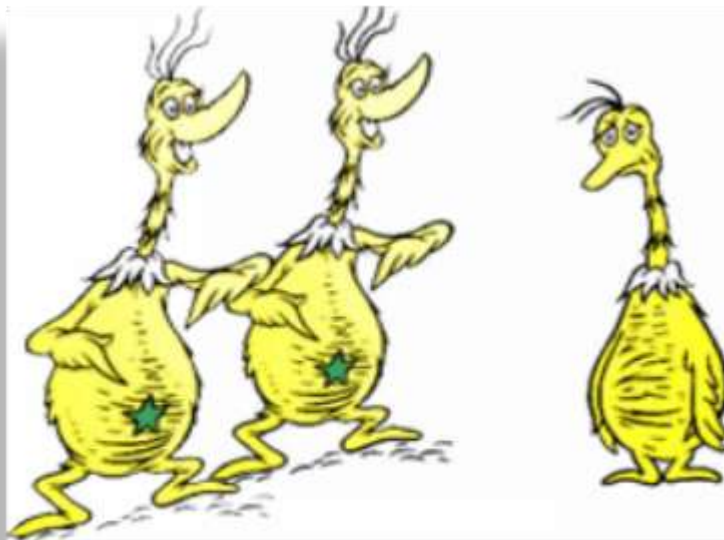
Na svakih 1000 normalnih Sneetches, rodi se 1001 sa zvezdom na stomaku



Privlačnost suprotnom polu



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Brzina Dominacije



Generacija	★	
1	50%	50%
10	50.2%	49.8%
100	52.5%	47.5%
1000	73.1%	26.9%
10 000	99.995%	0.005%
100 000	100%	0%

Posle 100 000 generacija, Sneetches bez zvezde vise ne postoje

U životu vreme ide samo u jednom smeru



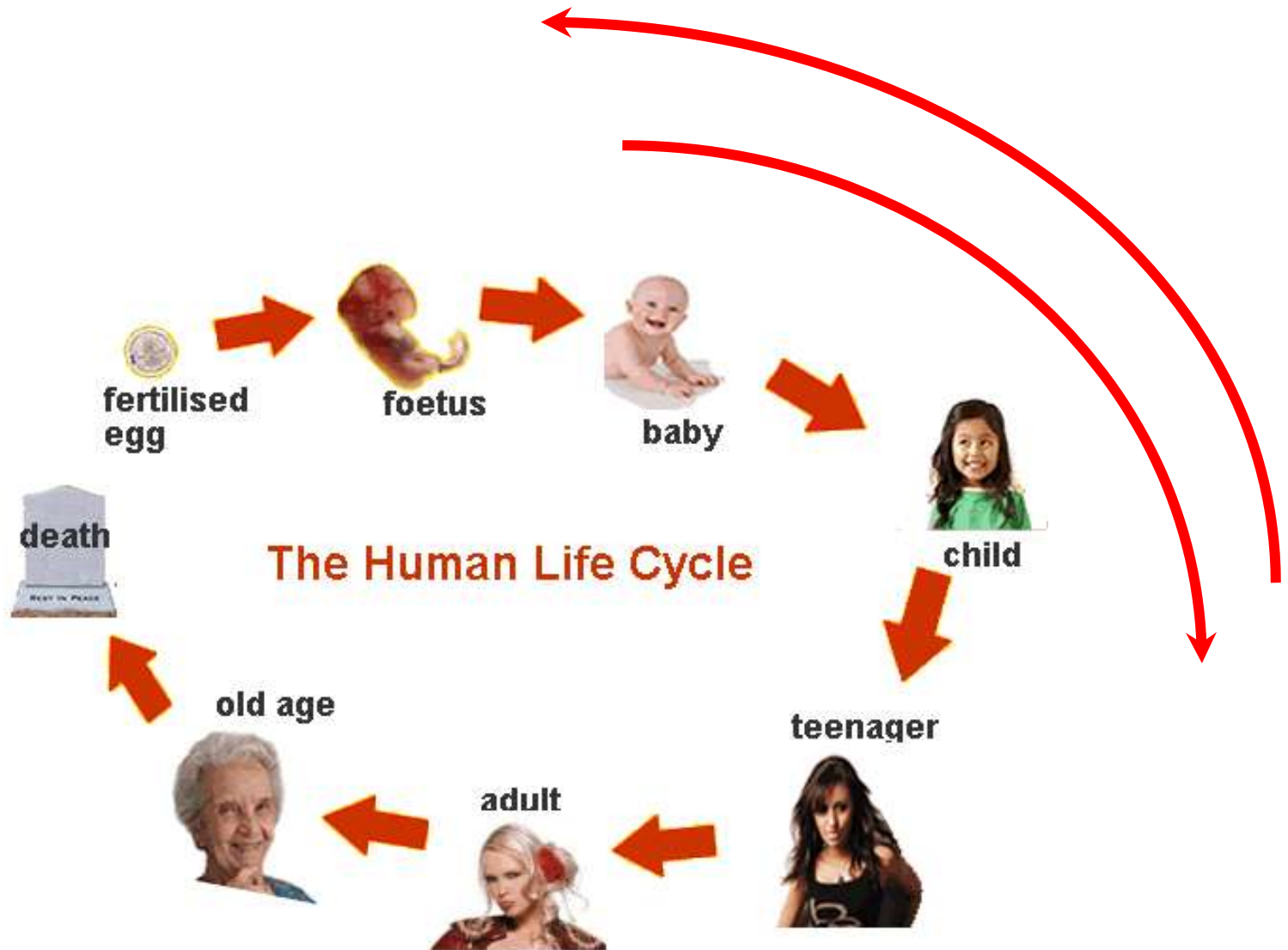
Jaje se uvek razbija (nikada se ne vraća u prvobitni oblik),

Casa se uvek lomi (nikada se ne sastavlja nazad)

Mi pamtimo prošlost (a ne pamtimo budućnost)



Strela (smer) Vremena



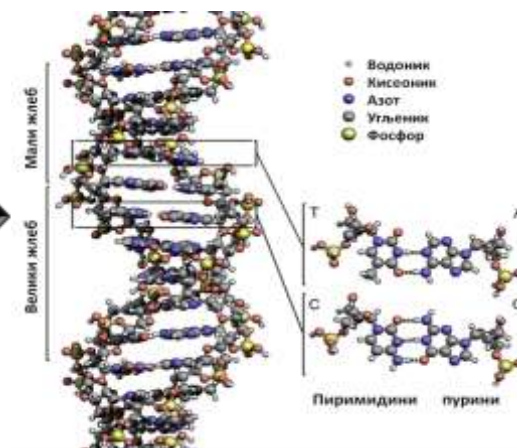
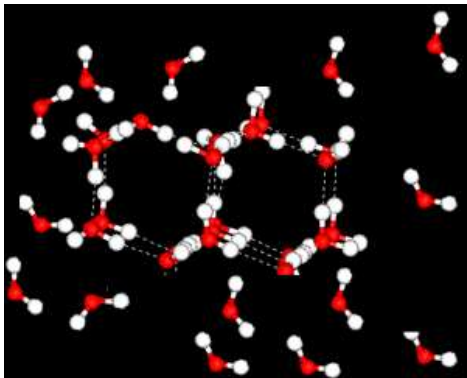
Drugi zakon termodinamike

U zatvorenom sistemu entropija (neuredjenost) uvek raste

Uredjeno



Neuredjeno



Drugi zakon termodinamike

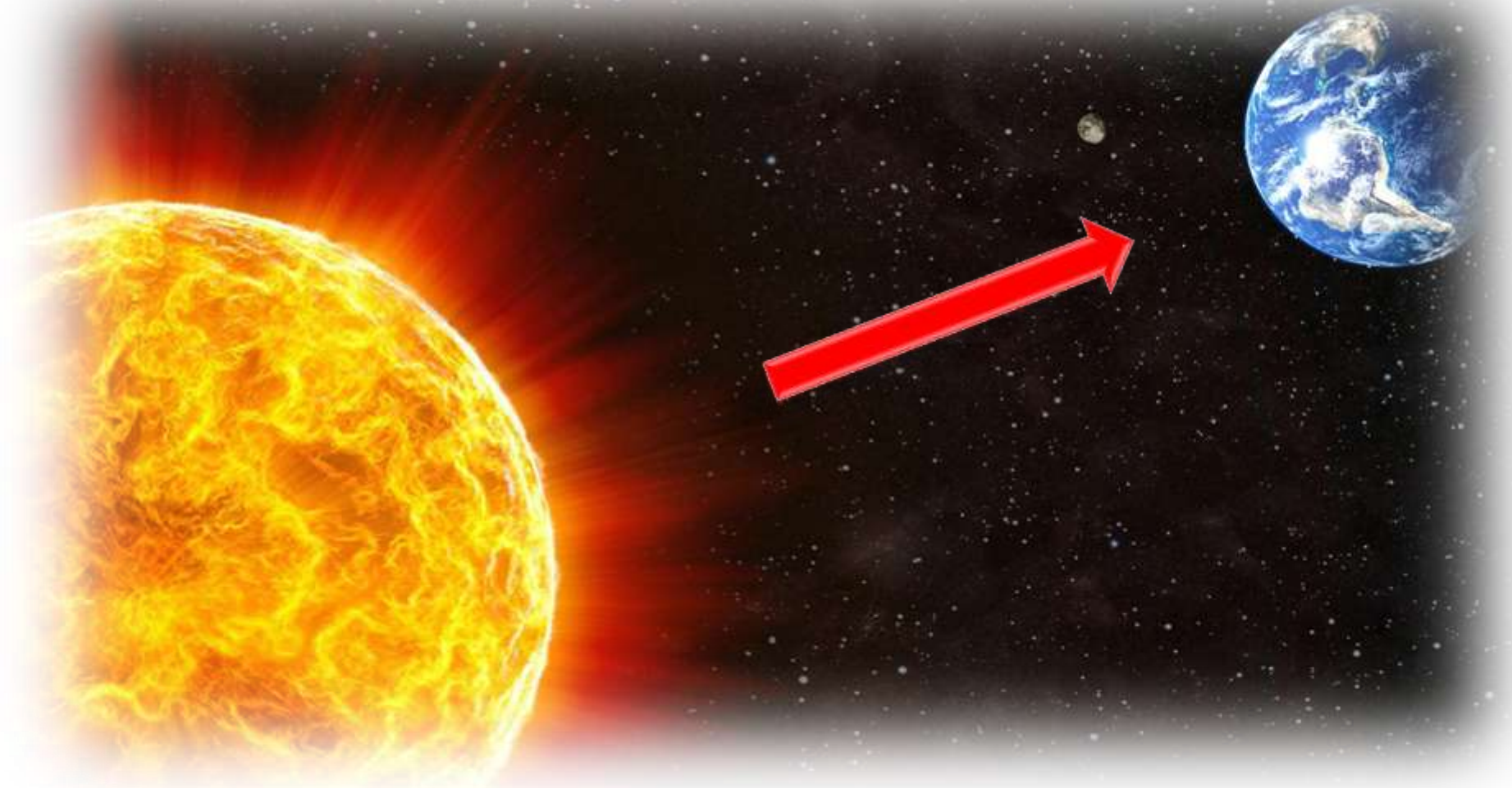
U zatvorenom sistemu entropija (neuredjenost) uvek raste

Spontana evolucija



Potreban uticaj sa strane (izvan sistema)

Zemlja nije zatvoreni sistem!



- Konstantan tok energije od Sunca prema Zemlji
- Sistem nije u ravnotezi
- Uredjenost moze da raste



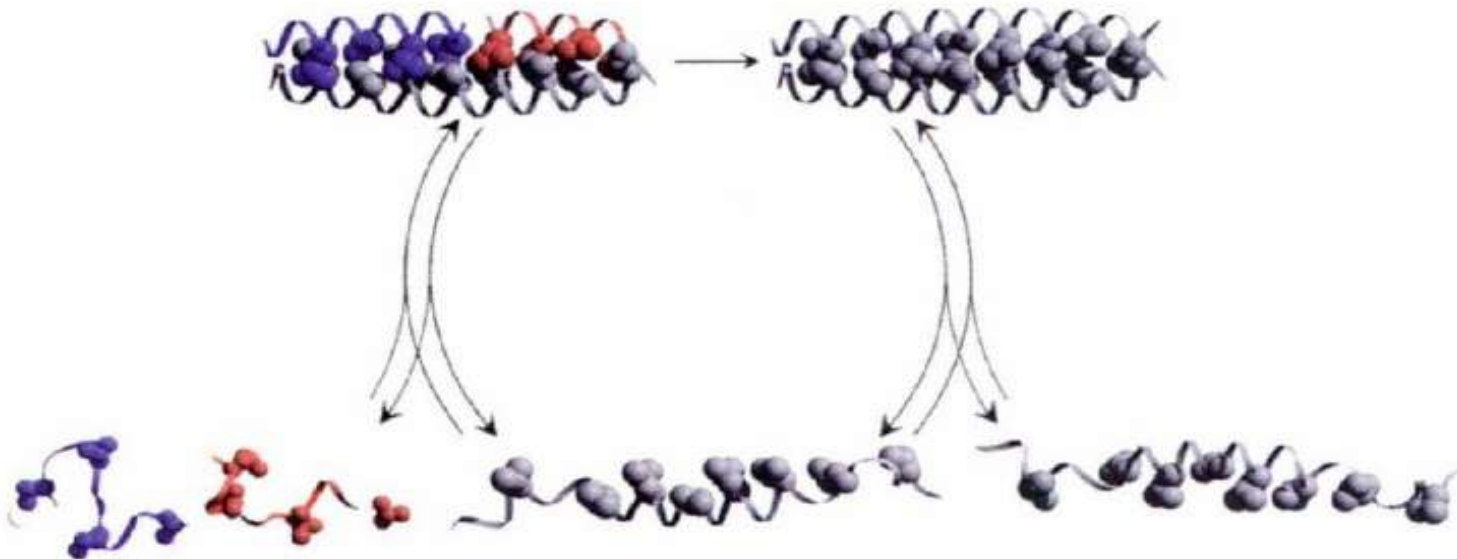
Samo-organizacija

Sistemi izvan ravnoteže ponekad se samo-organizuju
i prave složene strukture



Peptidi koji se samo-reprodukuju

Peptide Self-Replication

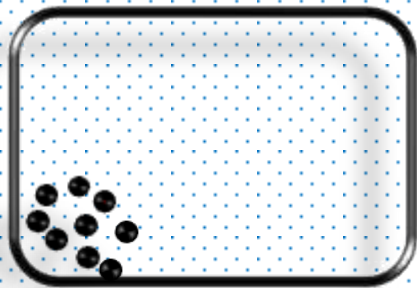


Lee, D. H.; Granja, J. R.; Martinez, J. A.; Severin, K.; Ghadri, M. R. *Nature* **1996**, 382, 525-8.

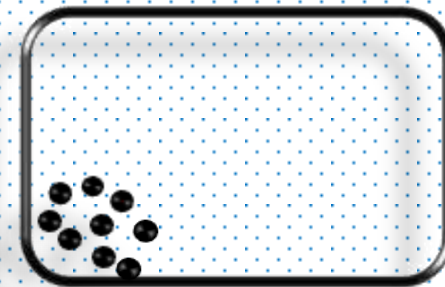
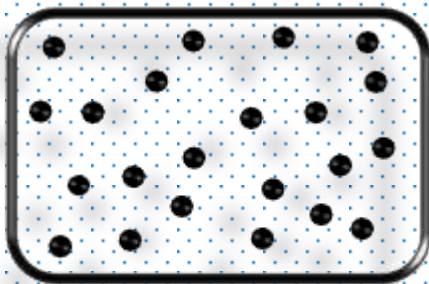
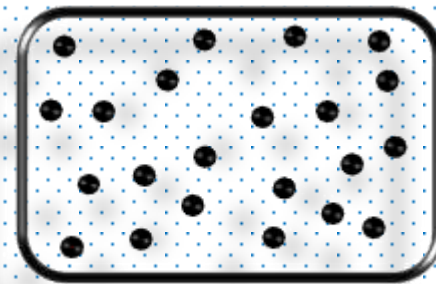
Peptid (deo proteina) sastavljen od 32 amino-kiseline koji pravi kopije samog sebe!

- Sistem van ravnoteže se uvek kreće ka ravnoteži

Van ravnoteže



Ravnoteža



U ravnoteži se ništa ne desava

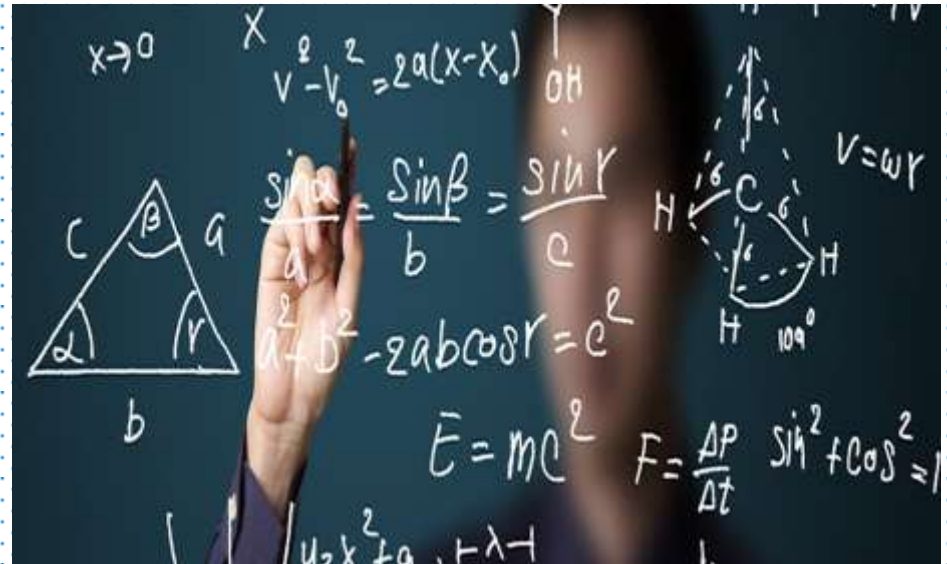
Da bi se nešto desavalo, neko mora da izvede sistem izvan ravnoteže

- Ko je izveo nas sistem izvan ravnoteže?

Dve Opcije



Bozanska intervencija

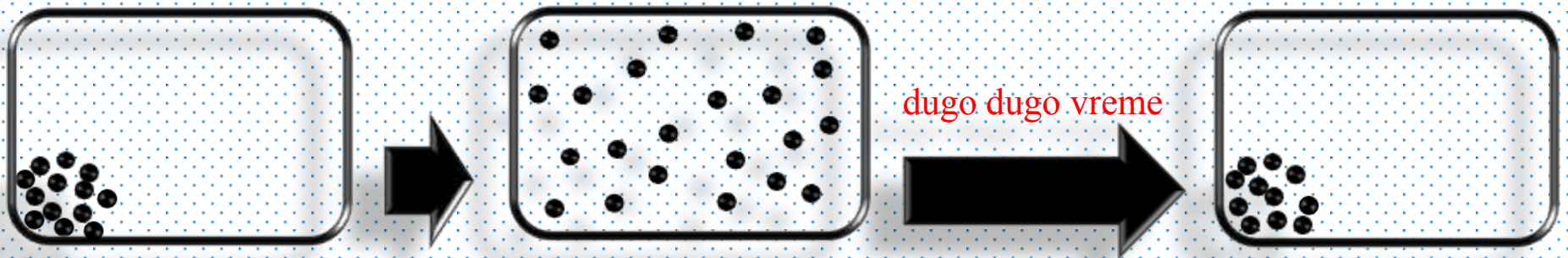


Prirodni zakoni fizike

Prirodni zakoni fizike

- Fizicki sistemi su podložni fluktuacijama
- Male fluktuacije se desavaju cesto
- Velike fluktuacije se desavaju retko

Ako cekamo dovoljno dugo vremena, desice se i velika, malo verovatna fluktuacija, i sistem moze se nadje daleko van ravnoteze



Kad je sistem van ravnoteze, strukture (pa i zivot) mogu da se formiraju

Ovo statisticko objasnjenje nastanka zivota nije bez problema

“Problem Boltzmann-ovog Mozga”

Minimalna fluktuacija konzistentna sa SVIM posmatranjima je:
Jedan jedini mozak stvoren zajedno sa memorijama i laznim iskustvom o prethodnom postjanju



Takva fluktuacija je mnogo manja i zato verovatnija nego fluktuacija koja bi dovela do Big Bang-a i normalne evolucije univerzuma

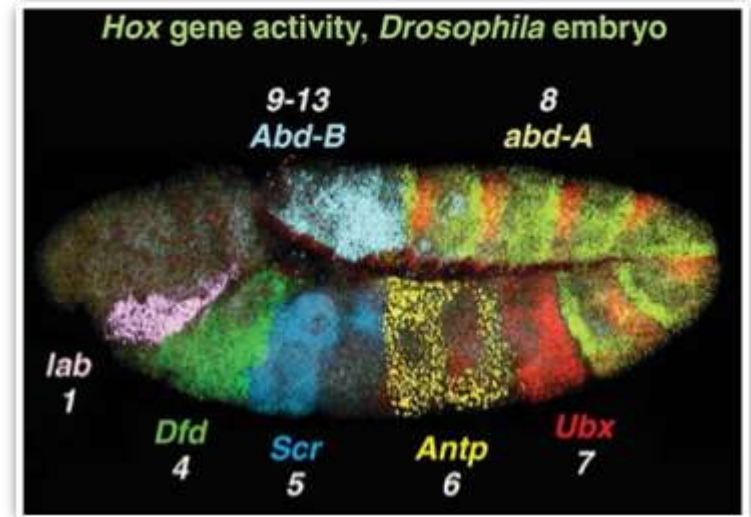
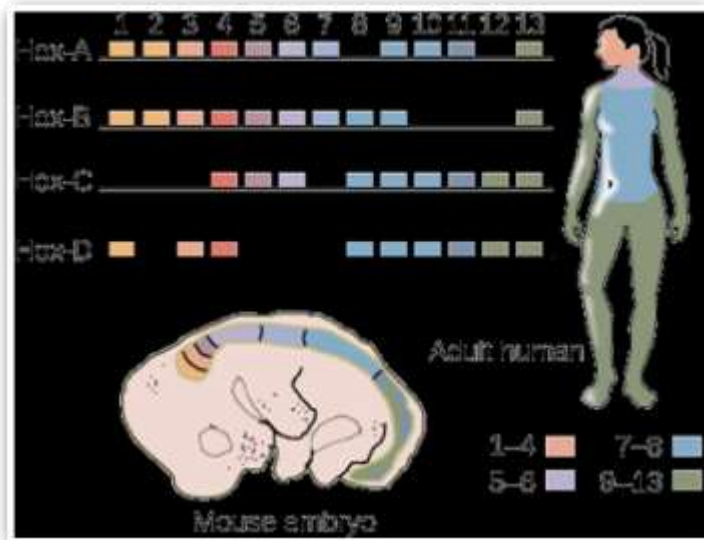
Besmrtnost

Geni se uglavnom repliciraju verno
(DNK: 1 greska u 10 milijardi nukleotida)

Radman, Nature **413** (2001) 115

Ljudski Hox geni su stari 700 miliona godina

Chourrot, *et al.*, Nature **442** (2006) 684



Geni su prakticno besmrtni

Kosmicki Kalendar

2001

Pre 2 milijarde godina



"Cupid and Psyche", Francois Gerard

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
1/01 JAN	DEC 31	1	2	3	4	5	6	1
	7	8	9	10	11	12	13	2
	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
FEB	4	5	6	7	8	9	10	6
	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
MAR	4	5	6	7	8	9	10	10
	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
2/01 APR	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
MAY	6	7	8	9	10	11	12	19
	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
JUN	3	4	5	6	7	8	9	23
	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
3/01 JUL	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
AUG	5	6	7	8	9	10	11	32
	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
SEP	26	27	28	29	30	31	SEP 1	35
	2	3	4	5	6	7	8	36
	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
4/01 OCT	23	24	25	26	27	28	29	39
	30	31	NOV 1	2	3	4	5	40
	6	7	8	9	10	11	12	41
	13	14	15	16	17	18	19	42
	20	21	22	23	24	25	26	43
NOV	27	28	29	30	31	DEC 1	2	44
	3	4	5	6	7	8	9	45
	10	11	12	13	14	15	16	46
	17	18	19	20	21	22	23	47
5/01 DEC	24	25	26	27	28	29	30	48
	1	2	3	4	5	6	7	49
	8	9	10	11	12	13	14	50
	15	16	17	18	19	20	21	51
	22	23	24	25	26	27	28	52

1. Novembar:
Izmisljen je seks

Besmrtnost



Jednocelijski organizmi se razmnozavaju prostom deobom
Celija roditelj i celija potomak su identicni
Bakterije, kao i njihovi geni su besmrtni



Kada su potrebne dve jedinke za razmnozavanje
Potomstvo vise nije identicno sa roditeljima
Ovim korakom se gubi besmrtnost !

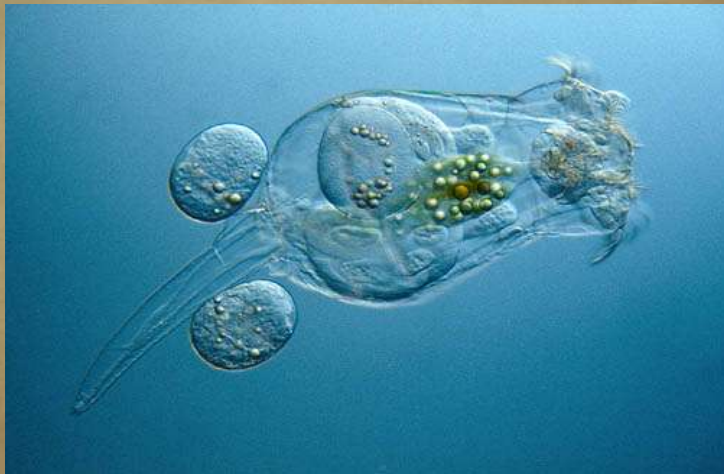
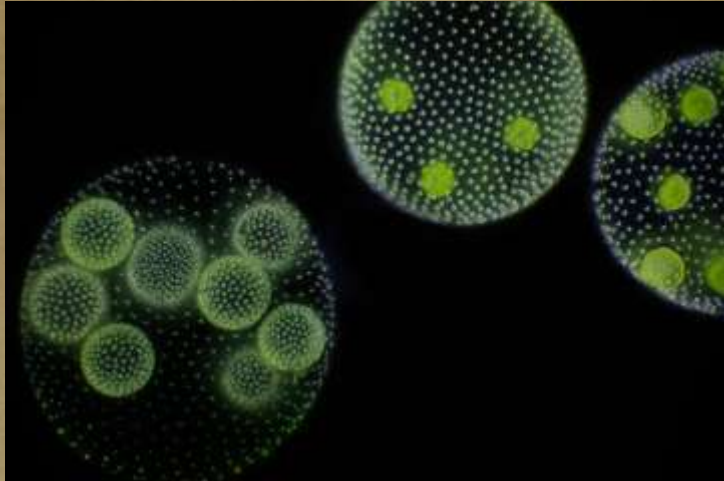
Smrt



Individualna smrtnost je posledica seksualne reprodukcije

Kosmicki Kalendar

2001



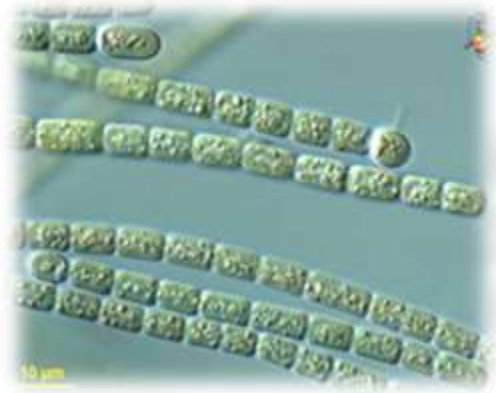
Pre 1.3 milijarde godina

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
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1/01	7	8	9	10	11	12	13	2
JAN	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
	4	5	6	7	8	9	10	6
FEB	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
	4	5	6	7	8	9	10	10
MAR	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
2/01	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
APR	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
	6	7	8	9	10	11	12	19
MAY	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
	3	4	5	6	7	8	9	23
JUN	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
	1	2	3	4	5	6	7	27
3/01	8	9	10	11	12	13	14	28
JUL	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
	5	6	7	8	9	10	11	32
AUG	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
	2	3	4	5	6	7	8	36
SEP	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
	30	31	OCT 1	2	3	4	5	40
4/01	6	7	8	9	10	11	12	41
APR	13	14	15	16	17	18	19	42
	20	21	22	23	24	25	26	43
	27	28	29	30	31	NOV 1	2	44
	3	4	5	6	7	8	9	45
MAY	10	11	12	13	14	15	16	46
	17	18	19	20	21	22	23	47
	24	25	26	27	28	29	30	48
	1	2	3	4	5	6	7	49
NOV	8	9	10	11	12	13	14	50
	15	16	17	18	19	20	21	51
	22	23	24	25	26	27	28	52
	29	30	DEC 1	2	3	4	5	53
DEC	6	7	8	9	10	11	12	54
	13	14	15	16	17	18	19	55
	20	21	22	23	24	25	26	56
	27	28	29	30	31	JAN 1	2	57

27. Novembar:
Multi-celijski organizmi



Jedna ljudska generacija: 20 godina



Jedna generacija prokariota (jednocelijskih organizama):
20 minuta
10,000 generacija u 138 dana

- Razvoj višecelijskih organizama je trajao 3.3 milijarde godina:
- 10^{14} (100 triliona) generacija!
- Vrlo spora evolucija



Kosmicki Kalendar

2001

Pre 650 miliona godina



Vernanimalcula guizhouena

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
	DEC 31	1	2	3	4	5	6	1
1/01	7	8	9	10	11	12	13	2
JAN	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
	4	5	6	7	8	9	10	6
FEB	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
	4	5	6	7	8	9	10	10
MAR	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
2/01	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
APR	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
	6	7	8	9	10	11	12	19
MAY	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
	3	4	5	6	7	8	9	23
JUN	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
3/01	15	16	17	18	19	20	21	29
JUL	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
	5	6	7	8	9	10	11	32
AUG	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
	2	3	4	5	6	7	8	36
SEP	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
	1	2	3	4	5	6	7	40
	8	9	10	11	12	13	14	41
4/01	15	16	17	18	19	20	21	42
APR	22	23	24	25	26	27	28	43
	29	30	MAY 1	2	3	4	5	44
	6	7	8	9	10	11	12	45
MAY	13	14	15	16	17	18	19	46
	20	21	22	23	24	25	26	47
	27	28	29	30	31	JUN 1	2	48
	3	4	5	6	7	8	9	49
JUN	10	11	12	13	14	15	16	50
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	24	25	26	27	28	29	30	52
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	8	9	10	11	12	13	14	54
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JUL	22	23	24	25	26	27	28	56
	29	30	31	AUG 1	2	3	4	57
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AUG	12	13	14	15	16	17	18	59
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SEP	9	10	11	12	13	14	15	63
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	23	24	25	26	27	28	29	65
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	8	9	10	11	12	13	14	67
6/01	15	16	17	18	19	20	21	68
APR	22	23	24	25	26	27	28	69
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MAY	13	14	15	16	17	18	19	72
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	27	28	29	30	31	JUN 1	2	74
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JUN	10	11	12	13	14	15	16	76
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	24	25	26	27	28	29	30	78
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7/01	15	16	17	18	19	20	21	81
JUL	22	23	24	25	26	27	28	82
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AUG	12	13	14	15	16	17	18	85
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SEP	9	10	11	12	13	14	15	89
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	1	2	3	4	5	6	7	92
	8	9	10	11	12	13	14	93
8/01	15	16	17	18	19	20	21	94
APR	22	23	24	25	26	27	28	95
	29	30	MAY 1	2	3	4	5	96
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MAY	13	14	15	16	17	18	19	98
	20	21	22	23	24	25	26	99
	27	28	29	30	31	JUN 1	2	100
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JUN	10	11	12	13	14	15	16	102
	17	18	19	20	21	22	23	103
	24	25	26	27	28	29	30	104
	1	2	3	4	5	6	7	105
	8	9	10	11	12	13	14	106
9/01	15	16	17	18	19	20	21	107
JUL	22	23	24	25	26	27	28	108
	29	30	31	AUG 1	2	3	4	109
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AUG	12	13	14	15	16	17	18	111
	19	20	21	22	23	24	25	112
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APR	22	23	24	25	26	27	28	121
	29	30	MAY 1	2	3	4	5	122
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MAY	13	14	15	16	17	18	19	124
	20	21	22	23	24	25	26	125
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	3	4	5	6	7	8	9	127
JUN	10	11	12	13	14	15	16	128
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	24	25	26	27	28	29	30	130
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11/01	15	16	17	18	19	20	21	133
JUL	22	23	24	25	26	27	28	134
	29	30	31	AUG 1	2	3	4	135
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AUG	12	13	14	15	16	17	18	137
	19	20	21	22	23	24	25	138
	26	27	28	29	30	31	SEP 1	139
	2	3	4	5	6	7	8	140
SEP	9	10	11	12	13	14	15	141
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	1	2	3	4	5	6	7	144
	8	9	10	11	12	13	14	145
12/01	15	16	17	18	19	20	21	146
APR	22	23	24	25	26	27	28	147
	29	30	MAY 1	2	3	4	5	148
	6	7	8	9	10	11	12	149
MAY	13	14	15	16	17	18	19	150
	20	21	22	23	24	25	26	151
	27	28	29	30	31	JUN 1	2	152
	3	4	5	6	7	8	9	153
JUN	10	11	12	13	14	15	16	154
	17	18	19	20	21	22	23	155
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JUL	22	23	24	25	26	27	28	160
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AUG	12	13	14	15	16	17	18	163
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2/02	15	16	17	18	19	20	21	172
APR	22	23	24	25	26	27	28	173
	29	30	MAY 1	2	3	4	5	174
	6	7	8	9	10	11	12	175
MAY	13	14	15	16	17	18	19	176
	20	21	22	23	24	25	26	177
	27	28	29	30	31	JUN 1	2	178
	3	4	5	6	7	8	9	179
JUN	10	11	12	13	14	15	16	180
	17	18	19	20	21	22	23	181
	24	25	26	27	28	29	30	182
	1	2	3	4	5	6	7	183
	8	9	10	11	12	13	14	184
3/02	15	16	17	18	19	20	21	185
JUL	22	23	24	25	26	27	28	186
	29	30	31	AUG 1	2	3	4	187
	5	6	7	8	9	10	11	188
AUG	12	13	14	15	16	17	18	189
	19	20	21	22				

Kambrijska Eksplozija



Ekstremno brz period evolucije pre 540 miliona godina

Kombinacija visecelijskih organizama i seksualne reprodukcije povećava raznovrsnost i omogućava evoluciji da se značajno ubrza



Geni su instrukcija kako da se razvija zivi organizam
Telo je samo kontejner koji stiti gene (informaciju)

Jedan isti gen se nalazi u mnogim telima
Kao sto se ista informacija nalazi u mnogim knjigama

9 od 10 celija u nasim telima nisu iskljucivo ljudske
(imaju ih drugi oblici zivota)

Kosmicki Kalendar

2001



Pre 60 miliona godina

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
1/01 JAN	DEC 31	1	2	3	4	5	6	1
	7	8	9	10	11	12	13	2
	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
FEB	4	5	6	7	8	9	10	6
	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
MAR	4	5	6	7	8	9	10	10
	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
2/01 APR	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
MAY	6	7	8	9	10	11	12	19
	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
JUN	3	4	5	6	7	8	9	23
	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
	3/01 JUL	1	2	3	4	5	6	7
8		9	10	11	12	13	14	28
15		16	17	18	19	20	21	29
22		23	24	25	26	27	28	30
29		30	31	AUG 1	2	3	4	31
AUG	5	6	7	8	9	10	11	32
	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
SEP	2	3	4	5	6	7	8	36
	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
	4/01 OCT	SEP 30	1	2	3	4	5	6
7		8	9	10	11	12	13	41
14		15	16	17	18	19	20	42
21		22	23	24	25	26	27	43
28		29	30	31	NOV 1	2	3	44
MAY	4	5	6	7	8	9	10	45
	11	12	13	14	15	16	17	46
	18	19	20	21	22	23	24	47
	25	26	27	28	29	30	DEC 1	48
JUN	2	3	4	5	6	7	8	49
	9	10	11	12	13	14	15	50
	16	17	18	19	20	21	22	51
	23	24	25	26	27	28	29	52

28. Decembar:
Prvi Primati

Prelazne forme u evoluciji Hominida

Simpanza
(nije nas predak)

Australopithecus
Africanus

Homo Erectus

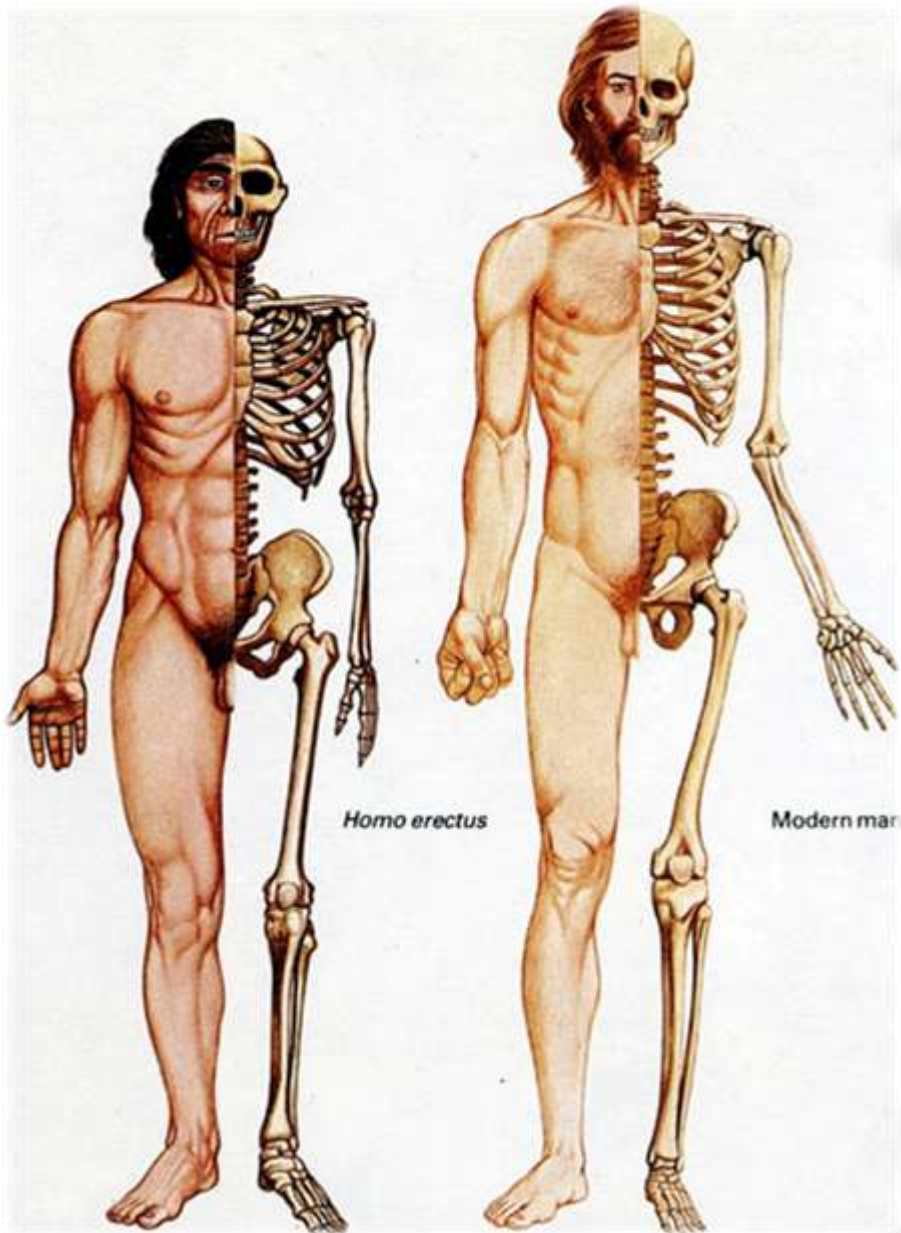


Genom je 99% identican!

Homo Sapiens
Neanderthalensis

Homo Sapiens
Sapiens

Evolucija: Od Homo Erektusa do Homo Sapiensa



2,000,000
godina



100,000
generacija



Kosmicki Kalendar

2001

31. Decembar:

10:30 PM.:

Prvi Ljudi

11:59:20 P.M.:

Poljoprivreda

11:59:56 P.M.:

Rimsko Carstvo

11:59:59 P.M.:

Renesansa

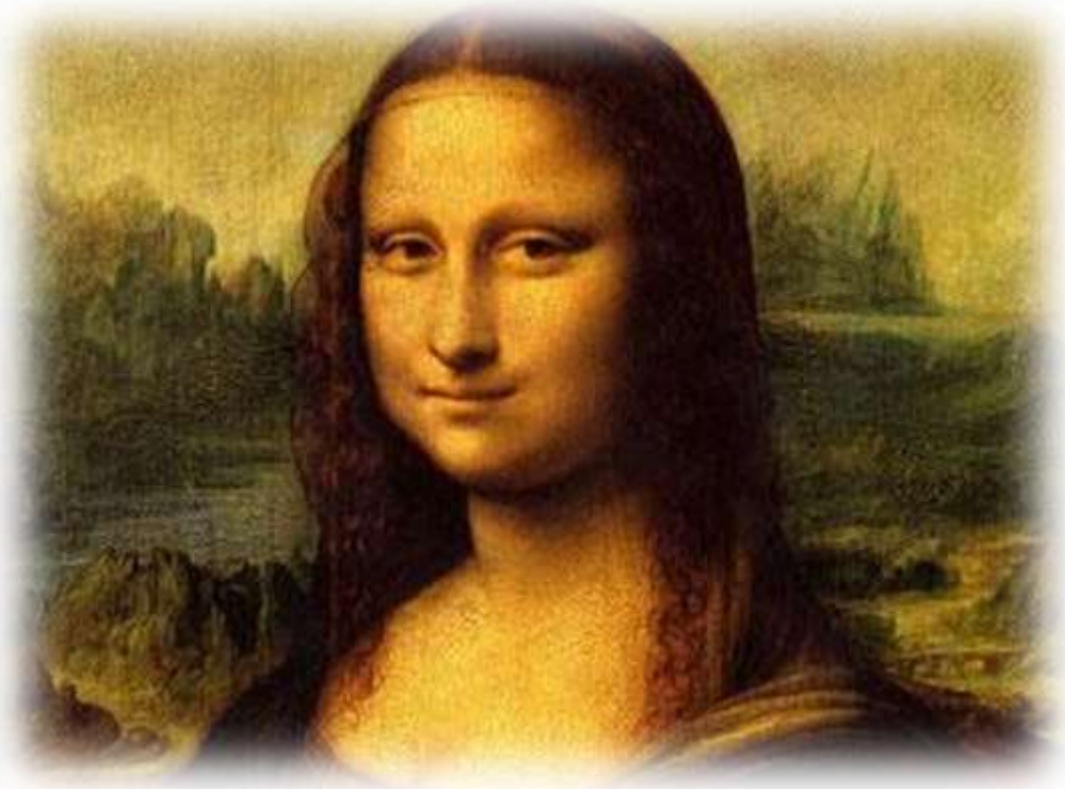
Moderna Nauka

	SUN	MON	TUE	WED	THU	FRI	SAT	Week No.
1/01 JAN	DEC 31	1	2	3	4	5	6	1
	7	8	9	10	11	12	13	2
	14	15	16	17	18	19	20	3
	21	22	23	24	25	26	27	4
	28	29	30	31	FEB 1	2	3	5
FEB	4	5	6	7	8	9	10	6
	11	12	13	14	15	16	17	7
	18	19	20	21	22	23	24	8
	25	26	27	28	MAR 1	2	3	9
MAR	4	5	6	7	8	9	10	10
	11	12	13	14	15	16	17	11
	18	19	20	21	22	23	24	12
	25	26	27	28	29	30	31	13
2/01 APR	1	2	3	4	5	6	7	14
	8	9	10	11	12	13	14	15
	15	16	17	18	19	20	21	16
	22	23	24	25	26	27	28	17
	29	30	MAY 1	2	3	4	5	18
MAY	6	7	8	9	10	11	12	19
	13	14	15	16	17	18	19	20
	20	21	22	23	24	25	26	21
	27	28	29	30	31	JUN 1	2	22
JUN	3	4	5	6	7	8	9	23
	10	11	12	13	14	15	16	24
	17	18	19	20	21	22	23	25
	24	25	26	27	28	29	30	26
3/01 JUL	1	2	3	4	5	6	7	27
	8	9	10	11	12	13	14	28
	15	16	17	18	19	20	21	29
	22	23	24	25	26	27	28	30
	29	30	31	AUG 1	2	3	4	31
AUG	5	6	7	8	9	10	11	32
	12	13	14	15	16	17	18	33
	19	20	21	22	23	24	25	34
	26	27	28	29	30	31	SEP 1	35
SEP	2	3	4	5	6	7	8	36
	9	10	11	12	13	14	15	37
	16	17	18	19	20	21	22	38
	23	24	25	26	27	28	29	39
4/01 OCT	SEP 30	1	2	3	4	5	6	40
	7	8	9	10	11	12	13	41
	14	15	16	17	18	19	20	42
	21	22	23	24	25	26	27	43
	28	29	30	31	NOV 1	2	3	44
MAY	4	5	6	7	8	9	10	45
	11	12	13	14	15	16	17	46
	18	19	20	21	22	23	24	47
	25	26	27	28	29	30	DEC 1	48
JUN	2	3	4	5	6	7	8	49
	9	10	11	12	13	14	15	50
	16	17	18	19	20	21	22	51
	23	24	25	26	27	28	29	52

31. Decembar

Svaka osoba za koju smi ikada culi, svi kraljevi, bitke, ratovi, celokupna ljudska istorija stane u poslednjih nekoliko sekundi kosmickog kalendara

Kultura



Evolucija ideja

Ljudska vrsta ima jedinstvenu sposobnost da siri informaciju bez gena: **ideje i koncepti**

(Richard Dawkins, 1976)



Nova vrsta evolucije: **Ideje mogu da evoluiraju nezavisno od svog tvorca ili bioloskog domacina**

Replikatori po prvi put ne moraju biti bioloske jedinice

Informacija preuzima ulogu zivota



Fundamentalna jedinica evolucije nije sam replikator,
nego informacija koju replikator sadrzi



Nase ideje, koncepti i ostvarenja mogu da putuju prema zvezdama i bez nas!



A mozda smo i mi samo necija ideja?

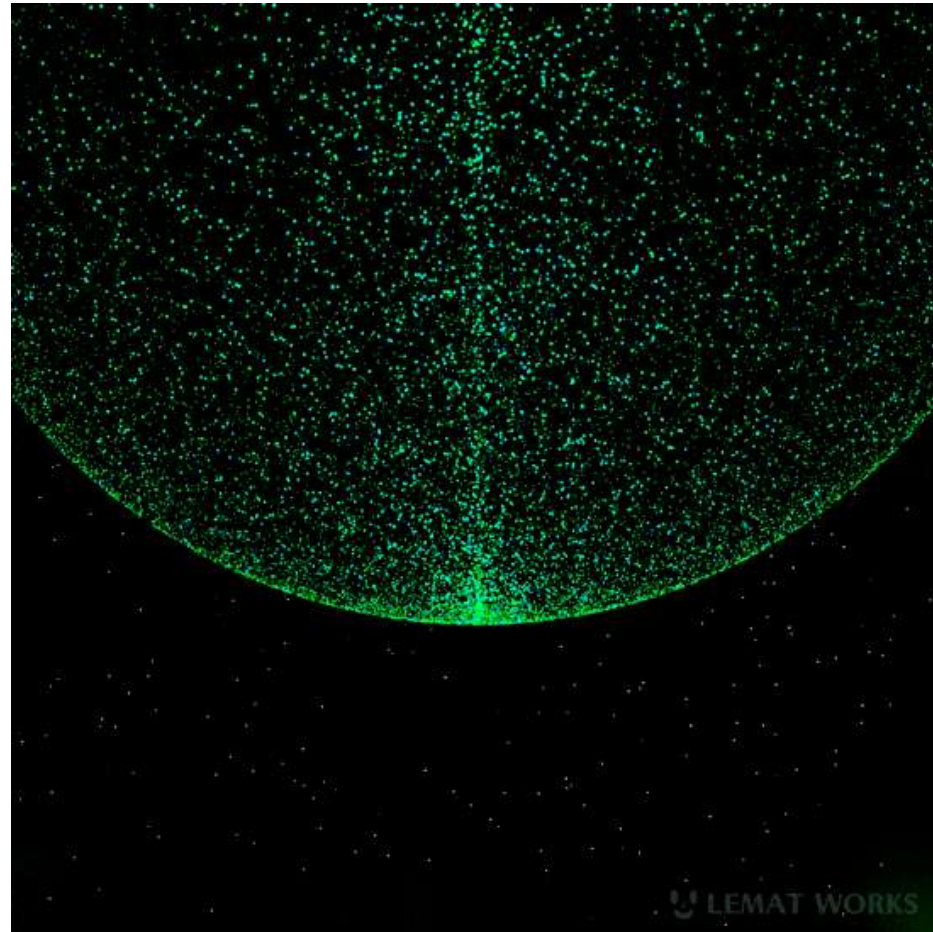
Kosmicki Kalendar



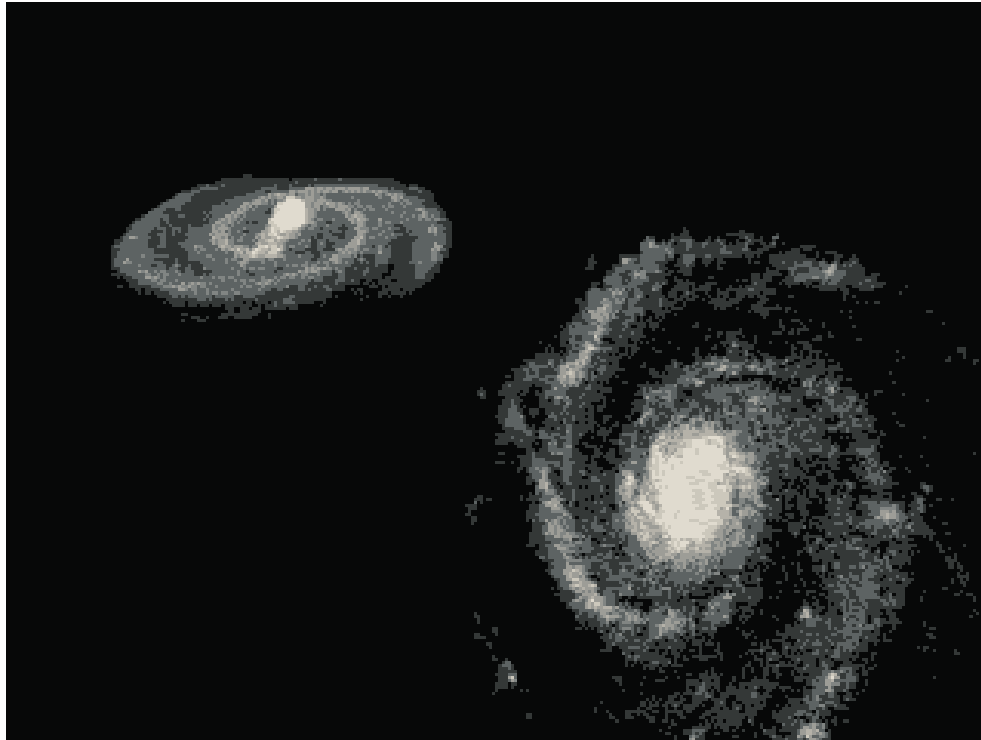
- U proteklih 14 milijardi godina dosta toga se desilo
- Sta ce se desiti u prvoj sekundi nove kosmicke godine zavisi od nas
- U svakom slucaju, Nova Kosmicka Godina ce doći sa nama ili bez nas



Sta nas ceka dalje?



Mlečni Put i Andromeda



Za 3 milijarde godina Mlečni Put i Andromeda će se spojiti u jednu galaksiju

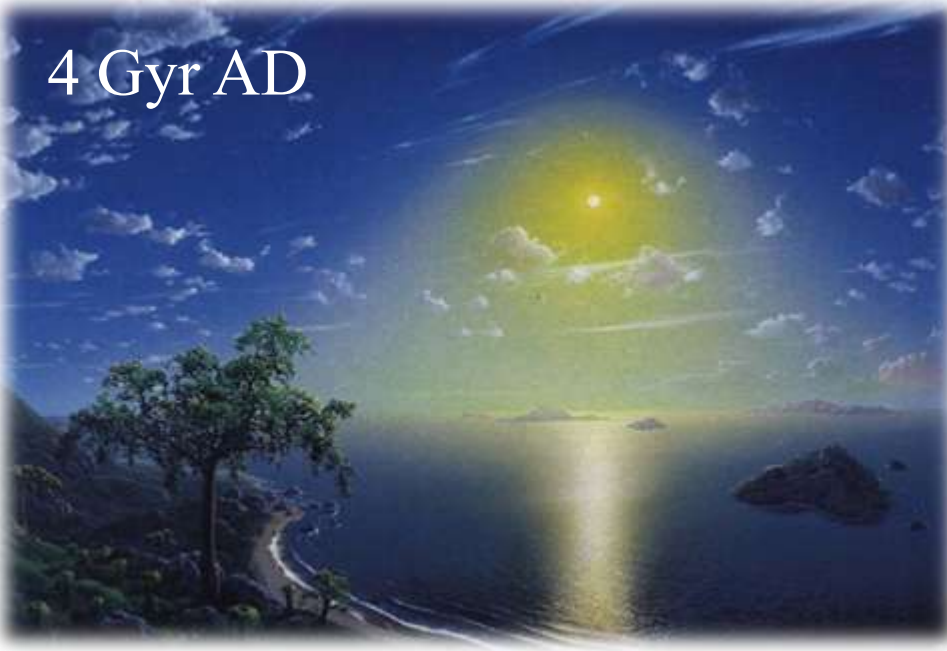
Sunce: Crveni Dzin



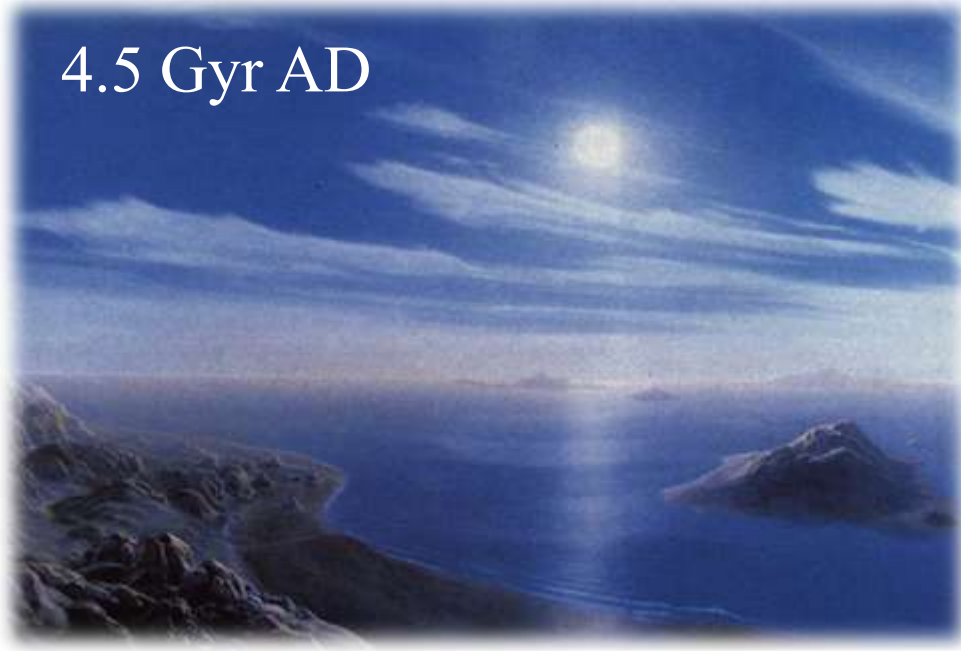
Za 5 milijardi godina Sunce postaje Crveni Dzin

Kraj Zivota na Zemlji...

4 Gyr AD



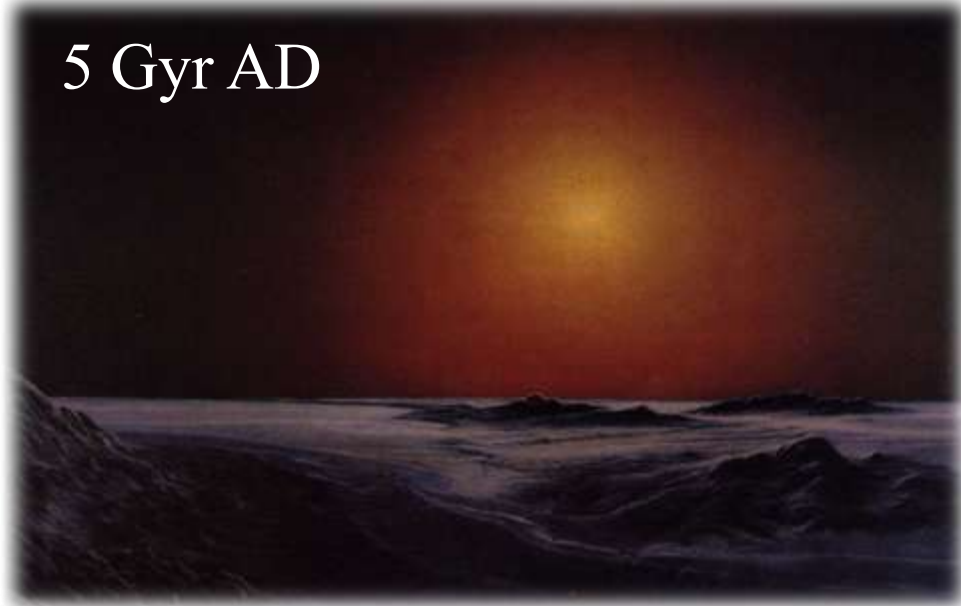
4.5 Gyr AD



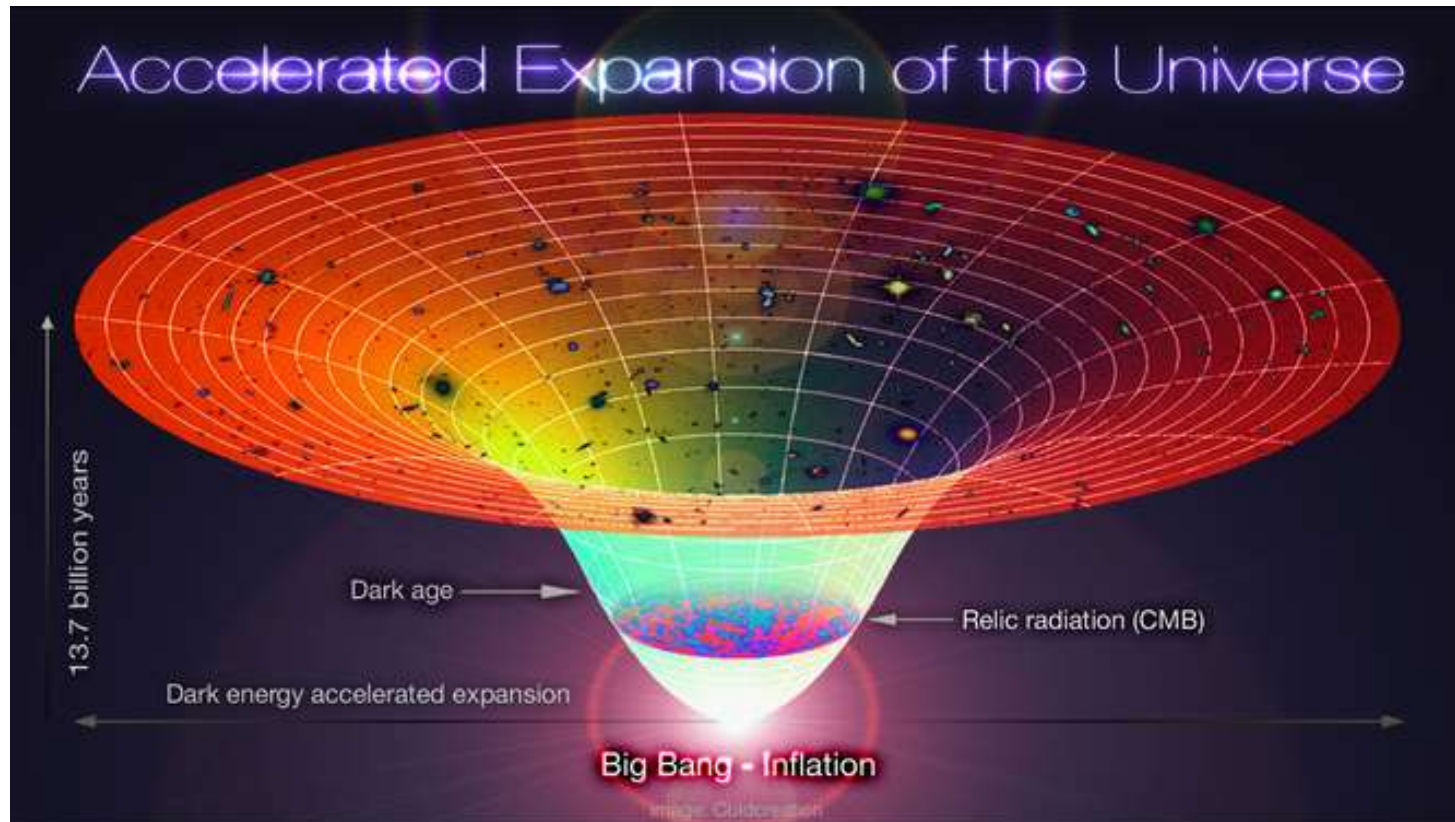
4.8 Gyr AD



5 Gyr AD



Ubrzana ekspanzija svemira



- Svemir se širi to sve brže i brže
- Regioni koji su nekada bili povezani biće izbaceni van horizonta
- Više nema (ni vizuelnog) kontakta između njih

Ubrzana ekspanzija svemira



- Za 100 milijardi godina ceo vidljivi svemir bice samo jedna galaksija
- Sve ostalo bice nam iza horizonta

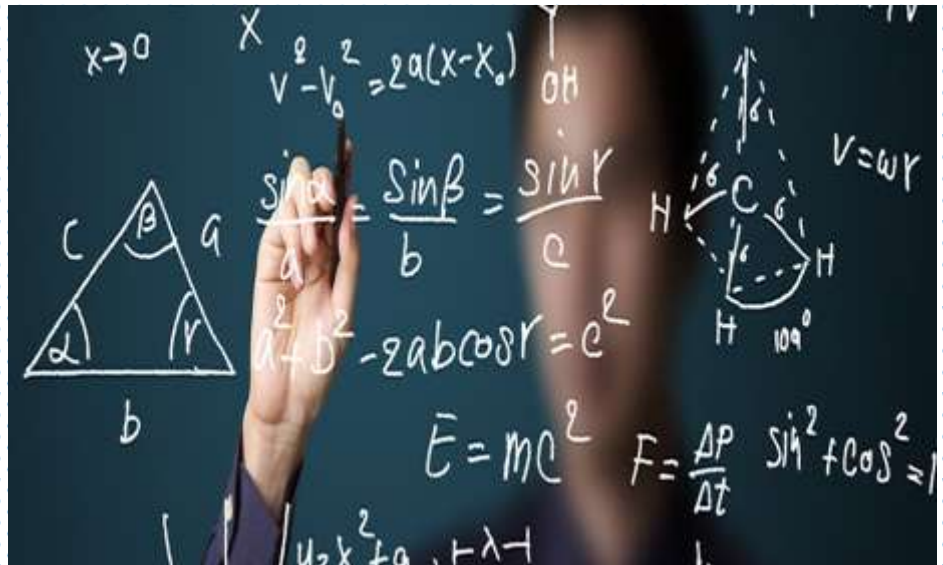
Konacno: Toplotna smrt vasionne

- Za 10^{100} godina temperatura u celom svemiru bice izjednacena
- Termodinamicka ravnoteza uspostavljena
- U ravnotezi se nista ne desava

Sve dok nas neko ponovo ne izvede izvan ravnoteže?



Bozanska intervencija



Prirodni zakoni fizike

Epilog

Ljudska moc apstraktnog logickog misljenja, premda izgleda kao da nema granica, ipak se pokazuje jedva doraslom graditeljskoj sposobnosti Prirode, koja izgleda kao da se sluzi logikom daleko superiornijom od nase.

Sa druge strane, sticuci razum i svest na nivou naseg intelekta, Priroda se susrece sa samom sobom. Da li je to zatvaranje nekog kruga kojeg jos uvek nismo u stanju da sagledamo.



B. Lalovic

HVALA

