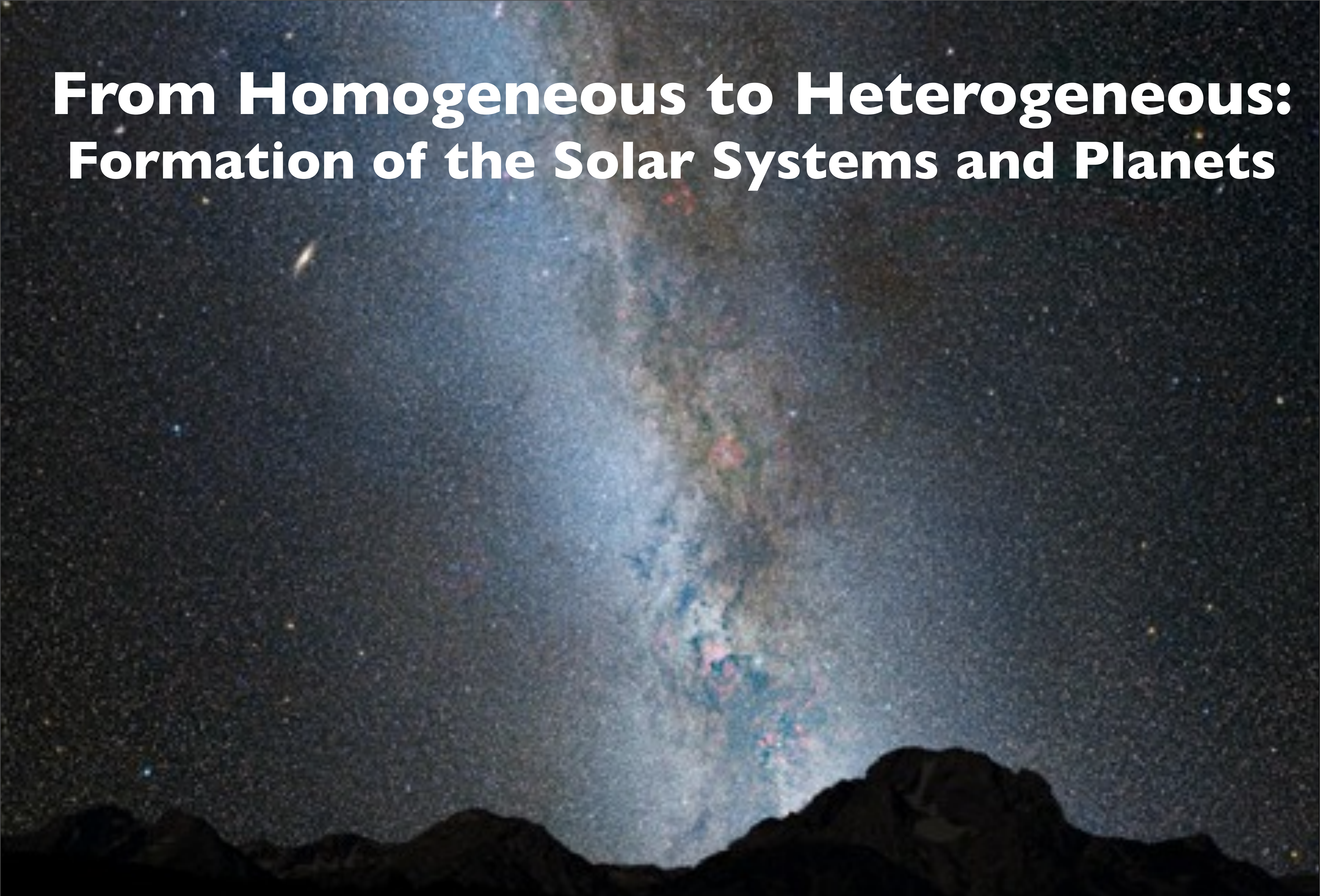
Earth - Home Sweet Home

From Homogeneous to Heterogeneous: Formation of the Solar Systems and Planets



Perspective on our place in the The Milky Way Galaxy video

Perspective on our place in the The Milky Way Galaxy video

Perspective on our place in the The Milky Way Galaxy video

Perspective on our place in the The Milky Way Galaxy video

ARE WE ALONE?


Hubble Ultra-Deep


Big Dipper
Sun
Hubble Ultra-Deep


Hubble Ultra-Deep
Big Dipper
Sun

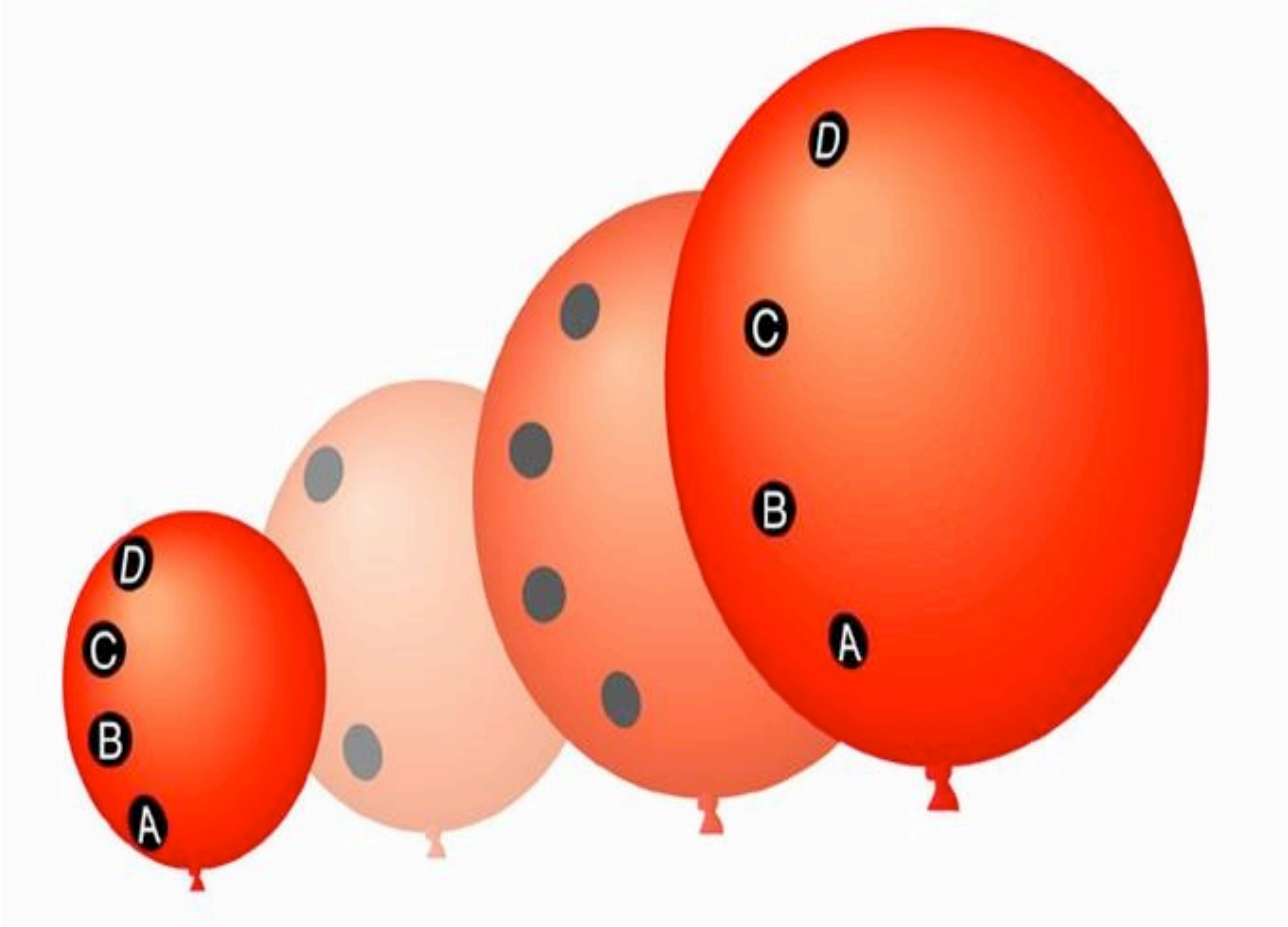

Big Dipper
Sun

Inside the Milky Way Galaxy

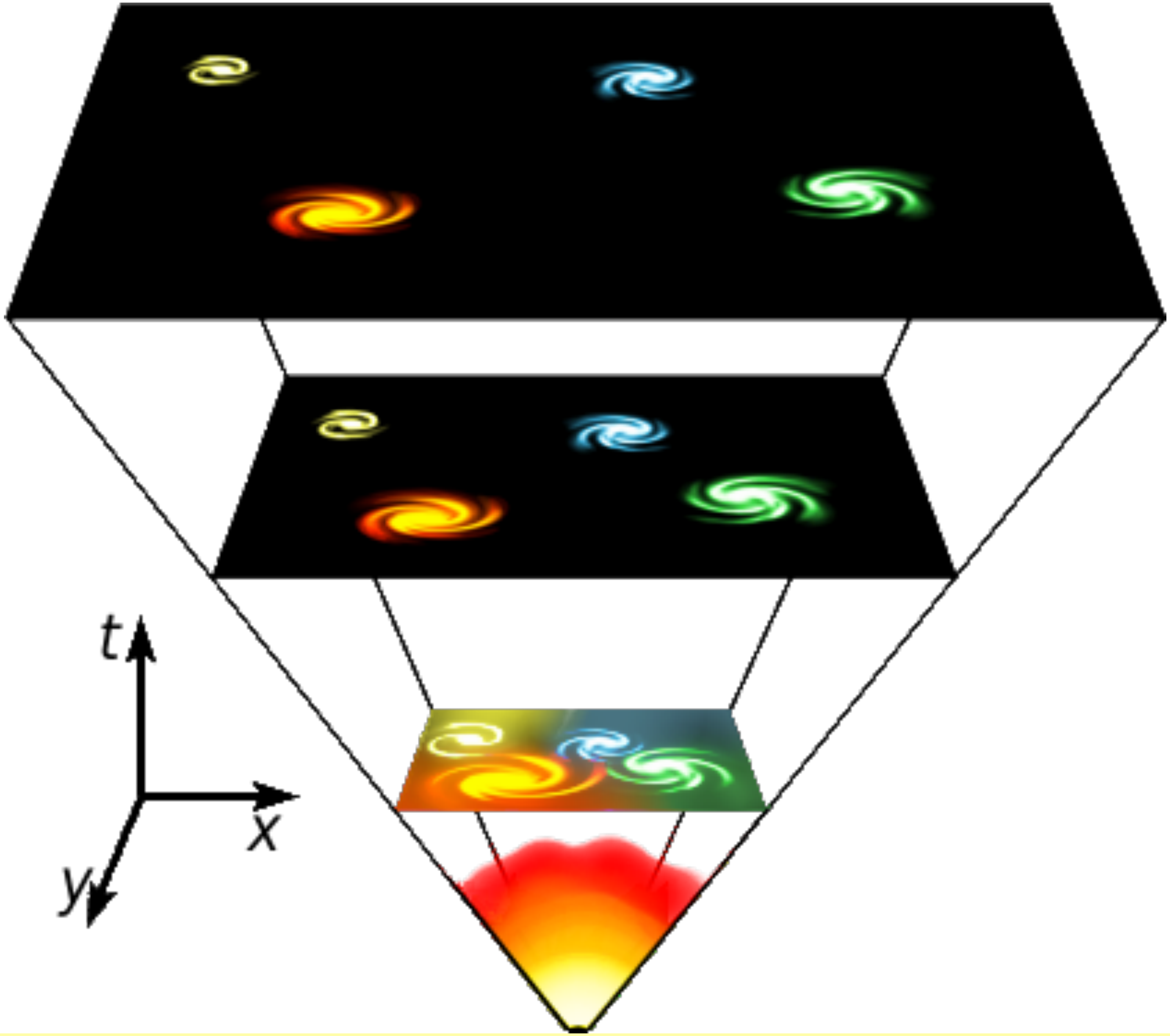
Mt. Lasen

Mt. Shasta


UNIVERSE FORMS
– 13.7 Billion Years Ago –
THE BIG BANG

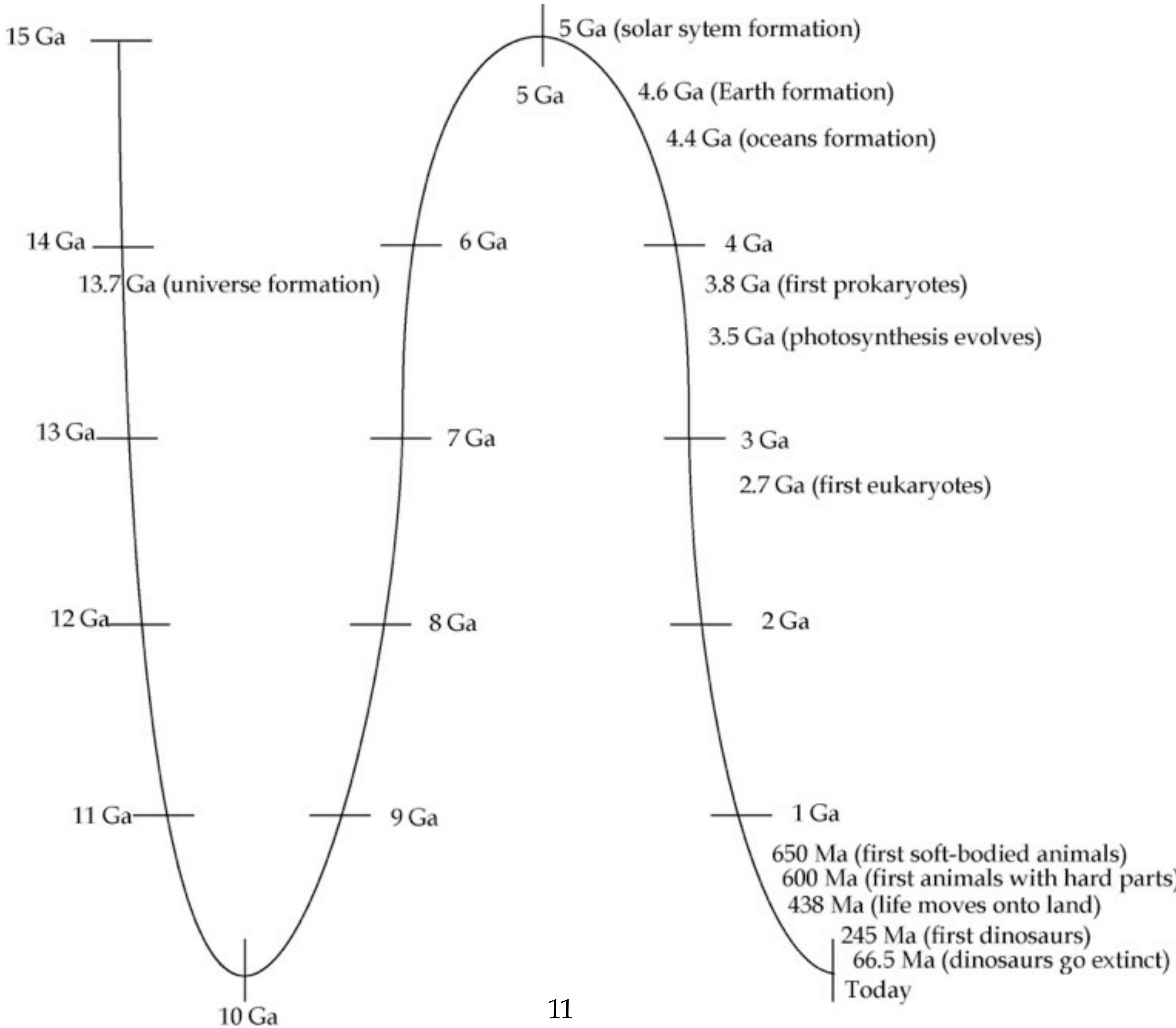


How We Know the Universe is 13.7 Billion Years Ago



How We Know the Universe is 13.7 Billion Years Ago

How we got to Today (Lecture Manual)



Earth History - Geologic Time

Today

Cenozoic

65 Ma

Mesozoic

245 Ma

Paleozoic

550 Ma

Proterozoic

2500 Ma

Archean

3800 Ma

Hadean

4560 Ma

Era	System and Series		Began mybp	Relative Time (1 dot or character = 1 million years)
Cenozoic	Quaternary	Holocene	0.01	
		Pleistocene	1.8	X
	Tertiary	Pliocene	5	W
		Miocene	23	
		Oligocene	34	
		Eocene	57	V U T
		Paleocene	65	S R Q
Mesozoic	Cretaceous		144	P O N M
	Jurassic		208	L K J I
	Triassic		245	H G F
Paleozoic	Permian		286	E
	Carboniferous Systems	Pennsylvanian	320	
		Mississippian	360	D
	Devonian		408	C B A 9
	Silurian		438	
	Ordovician		505	8 7
	Cambrian		544	
Precambrian	Proterozoic Era		2,500	6 5
	Archean Era		3,800	4 3 2
	Hadean Era		4,600	1 0

Events

- 0 Earth formed
- 1 Life originates
- 2 Oldest age-dated rocks
- 3 Blue-green algae
- 4 Bacteria
- 5 Cells with a nucleus
- 6 Multicellular life
- 7 Fish
- 8 Land plants
- 9 Insects
- A Amphibians
- B Sharks
- C Plants with seeds (ferns)
- D Reptiles
- E End-Permian extinction
- F Early dinosaurs (such as *Eoraptor*)
- G Mammals (shrew-like)
- H Turtles
- I *Archeopteryx*
- J *Apatosaurus*
- K *Allosaurus*
- L *Stegosaurus*
- M Flowering plants
- N Duck-billed dinosaurs
- O *Tricerotops*
- P *Tyrannosaurus rex*
- Q End-Cretaceous extinction
- R Dogs and cats
- S Grasses widespread
- T Pigs and deer
- U Horses (*Eohippus*)
- V Monkeys
- W Hominids
- X First of four ice ages

How we got to Today (Lecture Manual)

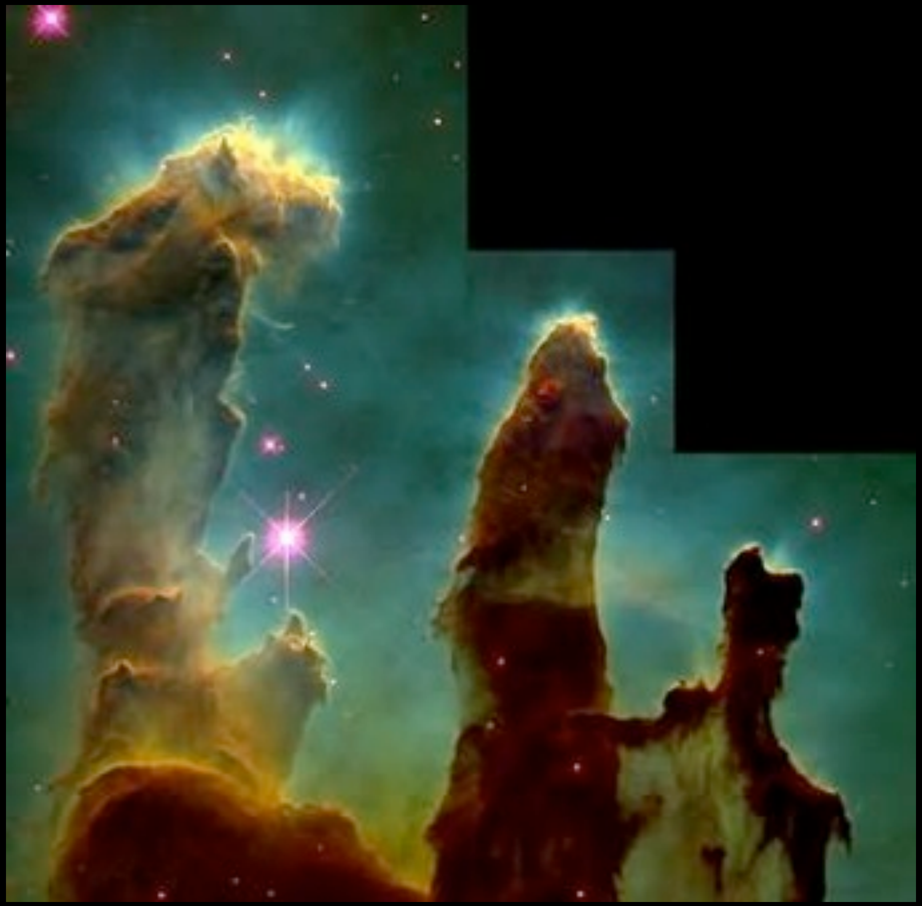
Geologic Time Scale (not to scale)

Eon		Era	Period	Epoch	Age	Events
Phanerozoic		**Cenozoic**	Quarternary	Holocene	10 Ka	
				Pleistocene	1.6 Ma	Wisconsin ice age (10-25 Ka) Fort Funston marine terrace formed (100 Ka) (CALIF) Illinoisian ice age (130-270 Ka) Homo Sapiens first appear (100-300 Ka) Eruption of Mt. Lassen spews ash across state (400 Ka) (CALIF) Kansan ice age (350-600 Ka) San Francisco Bay forms (400 Ka) (CALIF) Nebraskan ice age (1-2 Ma) Merced formation begins accumulating (1 Ma) (CALIF)
			Tertiary	Pliocene	5.3 Ma	Ancient hominids first appear (3.4-3.8 Ma) Purisima Formation deposited (Moss Beach) (3-5 Ma) (CALIF) Uplift of Coast Ranges and Mt. Diablo begins (5 Ma) (CALIF)
				Miocene	23.7 Ma	
				Oligocene	36.6 Ma	San Andreas fault formed (25 Ma) (CALIF)
				Eocene	57.8 Ma	
				Paleocene	66.4 Ma	
		Mesozoic	Cretaceous	Upper	97.5 Ma	Last dinosaur (66.4 Ma) Montara Mountain granite forms in Sierras (88 Ma) (CALIF) First modern mammal (90 Ma)
				Lower	144 Ma	Marin Headlands Terrane accretes in Franciscan Subduction Zone (100 Ma) (CALIF)
			Jurassic		208 Ma	Pangaea break up (Atlantic Ocean) (175 Ma) Franciscan subduction zone (65-175 Ma) (CALIF) Marin Headlands Chert and Shale accumulate on seafloor (100-200 Ma) (CALIF) Marin Headlands Pillow Basalt forms at spreading center (200 Ma) (CALIF)
			Triassic		245 Ma	Pangaea formation is complete (225 Ma) Smartville subduction zone (175-225 Ma) (CALIF) First dinosaur (228 Ma)
		Paleozoic	Permian		286 Ma	Mass extinction event (245 Ma)
			Carboniferous	Pennsylvanian	320 Ma	First reptiles
				Mississippian	360 Ma	First bony fish (360 Ma)
			Devonian		408 Ma	First amphibians Sonomia subduction zone (225- 375 Ma) (CALIF) First forests and insects (400 Ma)
			Silurian		438 Ma	First land plants
			Ordovician		505 Ma	First primitive fishes
			Cambrian		570 Ma	First trilobite (540 Ma) First organisms with shells (570 Ma)
Precambrian	Proterozoic	Late			900 Ma	First multicelled organisms (670 Ma) North American western margin is passive (900-400 Ma) (CALIF)
		Middle			1.6 Ga	
		Early			2.5 Ga	First one-celled organisms with nucleus (2.2 Ga)
	Archean	Late			3.0 Ga	
		Middle			3.4 Ga	
		Early			3.8 Ga	First evidence of photosynthesis (stromatolites) (3.5 Ga) First evidence of life (bacteria – single celled with no nucleus) (3.8 Ga)
	Hadean				4.6 Ga	Formation of oceans and oldest known rocks (4.4 Ga) Formation of Earth and its immediate differentiation into layers (4.6 Ga)

*Age is when division begins: Ka = thousands of years old; Ma = millions of years old; Ga = billions of years old.

Solar Nebula Hypothesis

Orion nebula (stellar nursery)

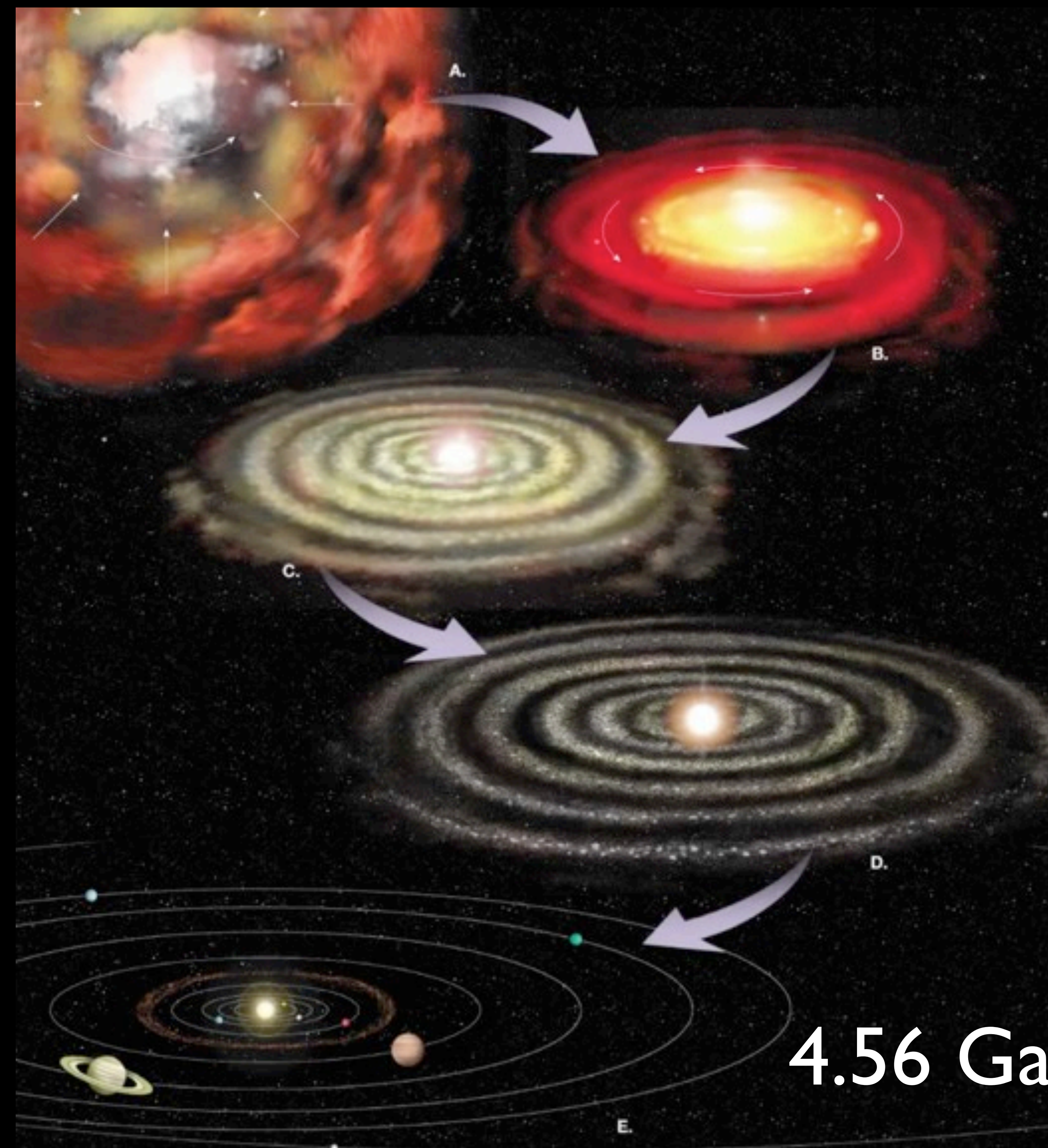


Star Birth

Solar Nebula Hypothesis

Orion nebula (stellar nursery)

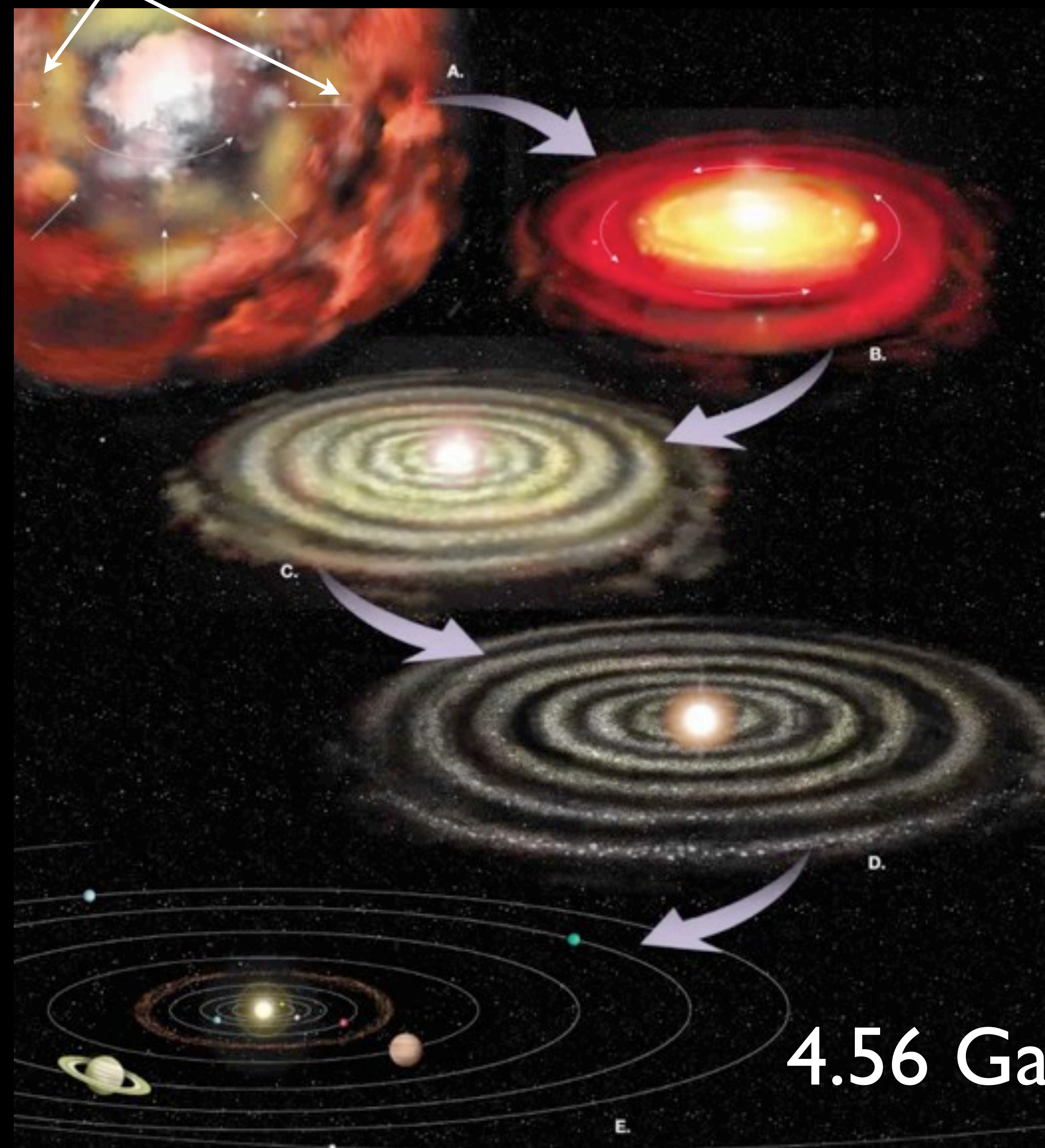
Star Birth



Solar Nebula Hypothesis

Orion nebula (stellar nursery)

Homogeneous nebula
(74% H, 24% He, 2% other)



Star Birth

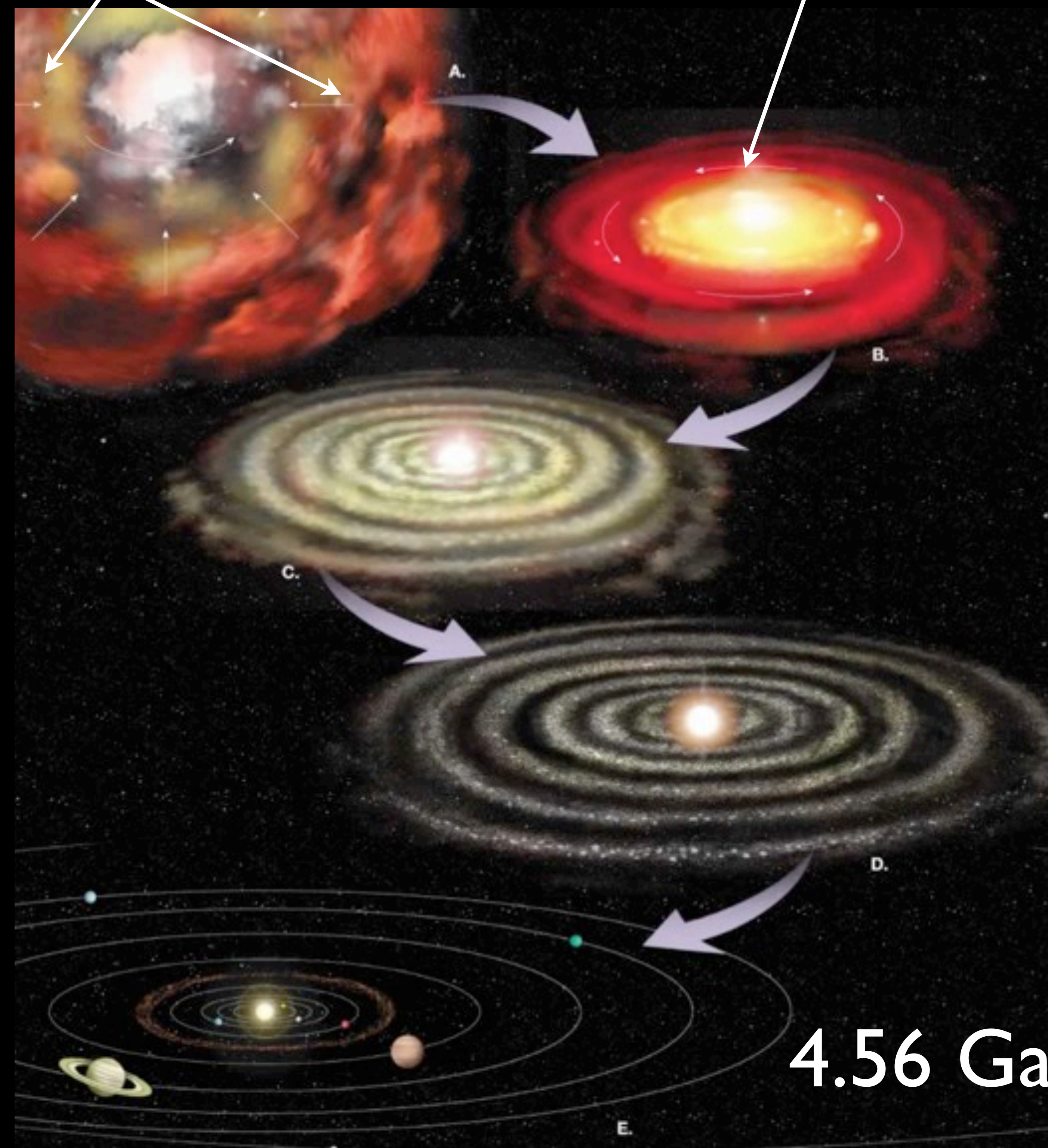
Solar Nebula Hypothesis

98.8% of solar system mass is in the sun

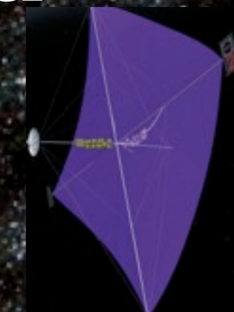
Homogeneous nebula
(74% H, 24% He, 2% other)

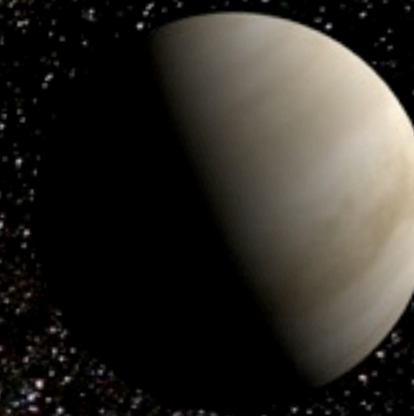
Orion nebula (stellar nursery)

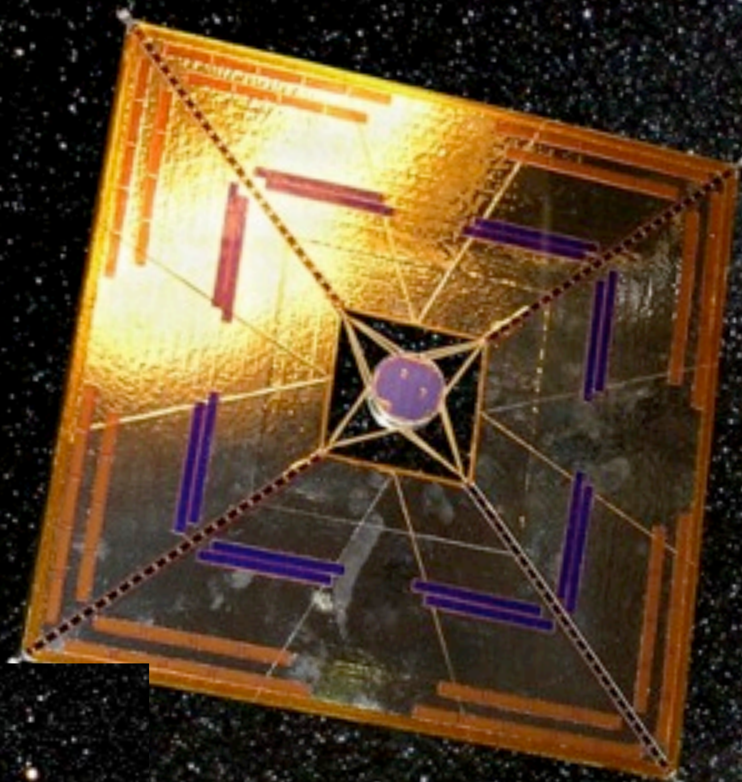
Star Birth

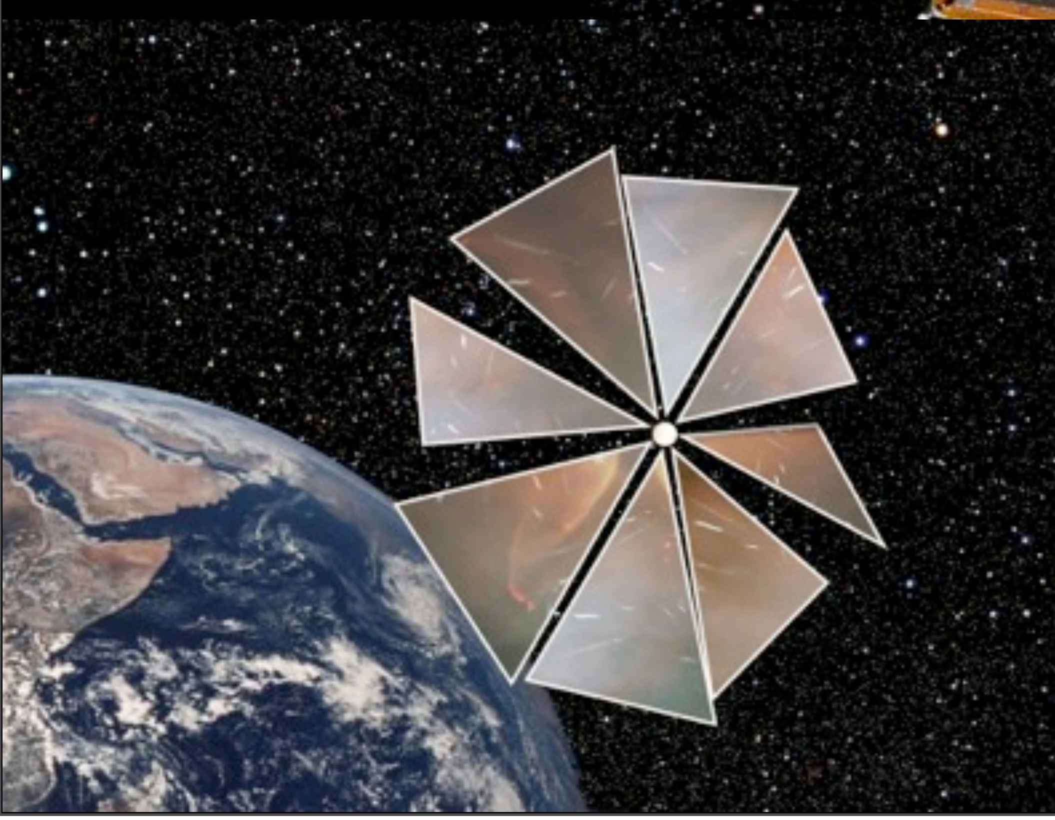


Differentiation of the solar system by the Solar Wind









Accretionary disk around a Proto-star

Solar Nebula Hypothesis

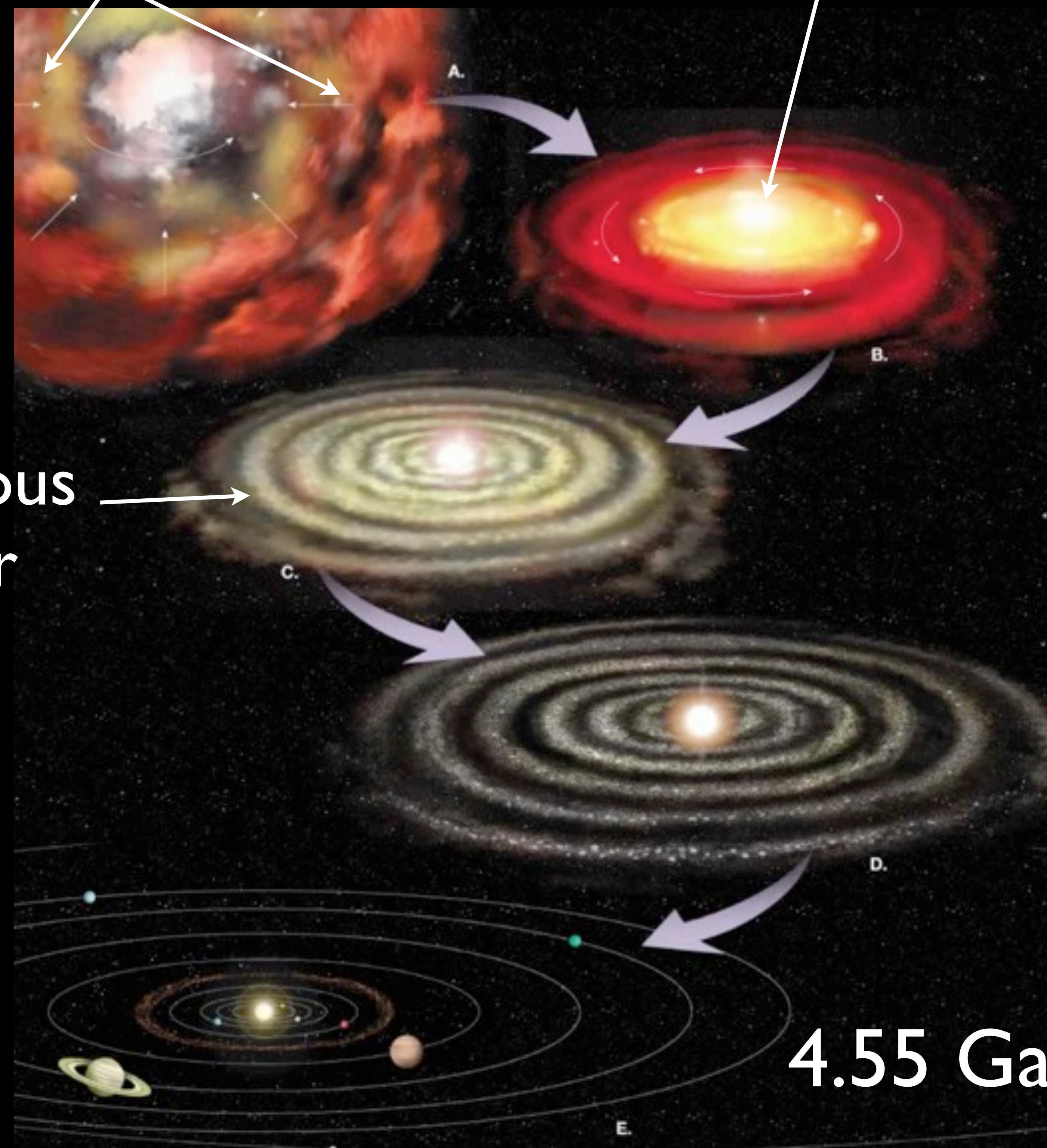
98.8% of solar system mass is in the sun

Homogeneous nebula (74% H, 24% He, 2% other)

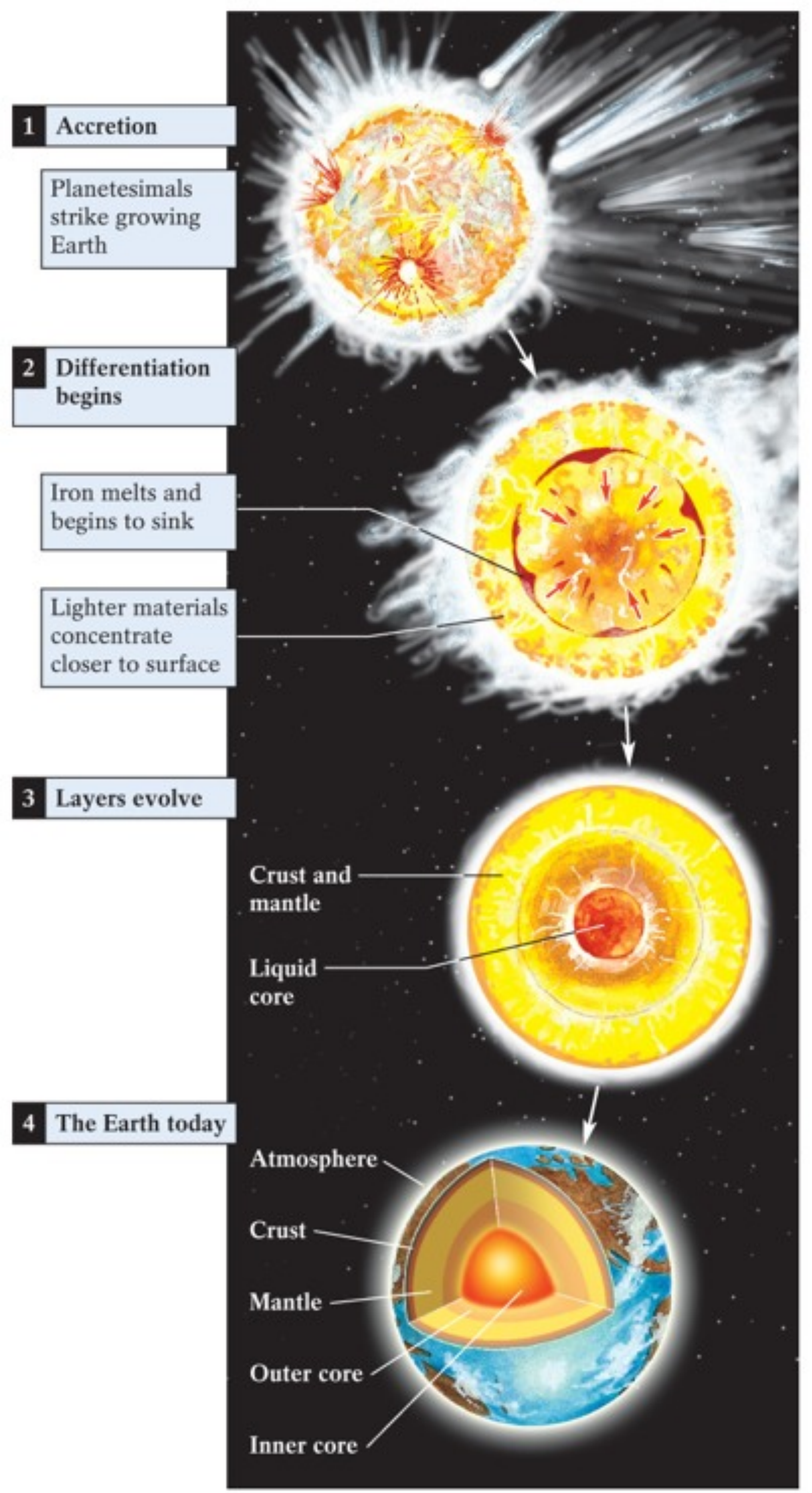
Orion nebula (stellar nursery)

Star Birth

Heterogeneous proto-solar system



Planetary Formation by Accretion



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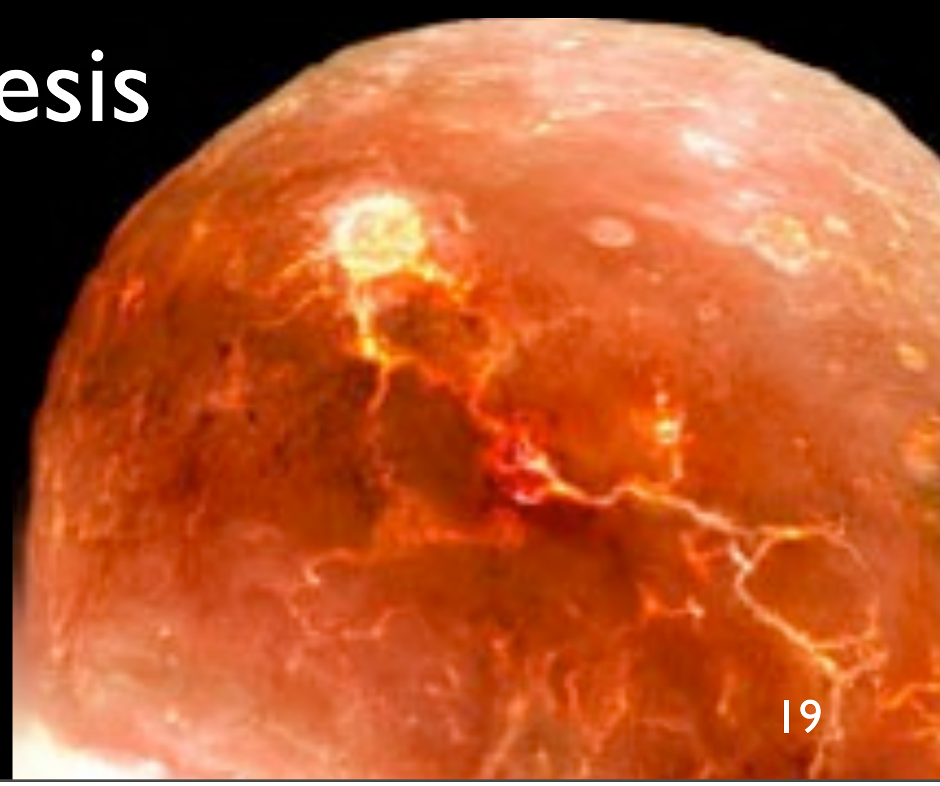
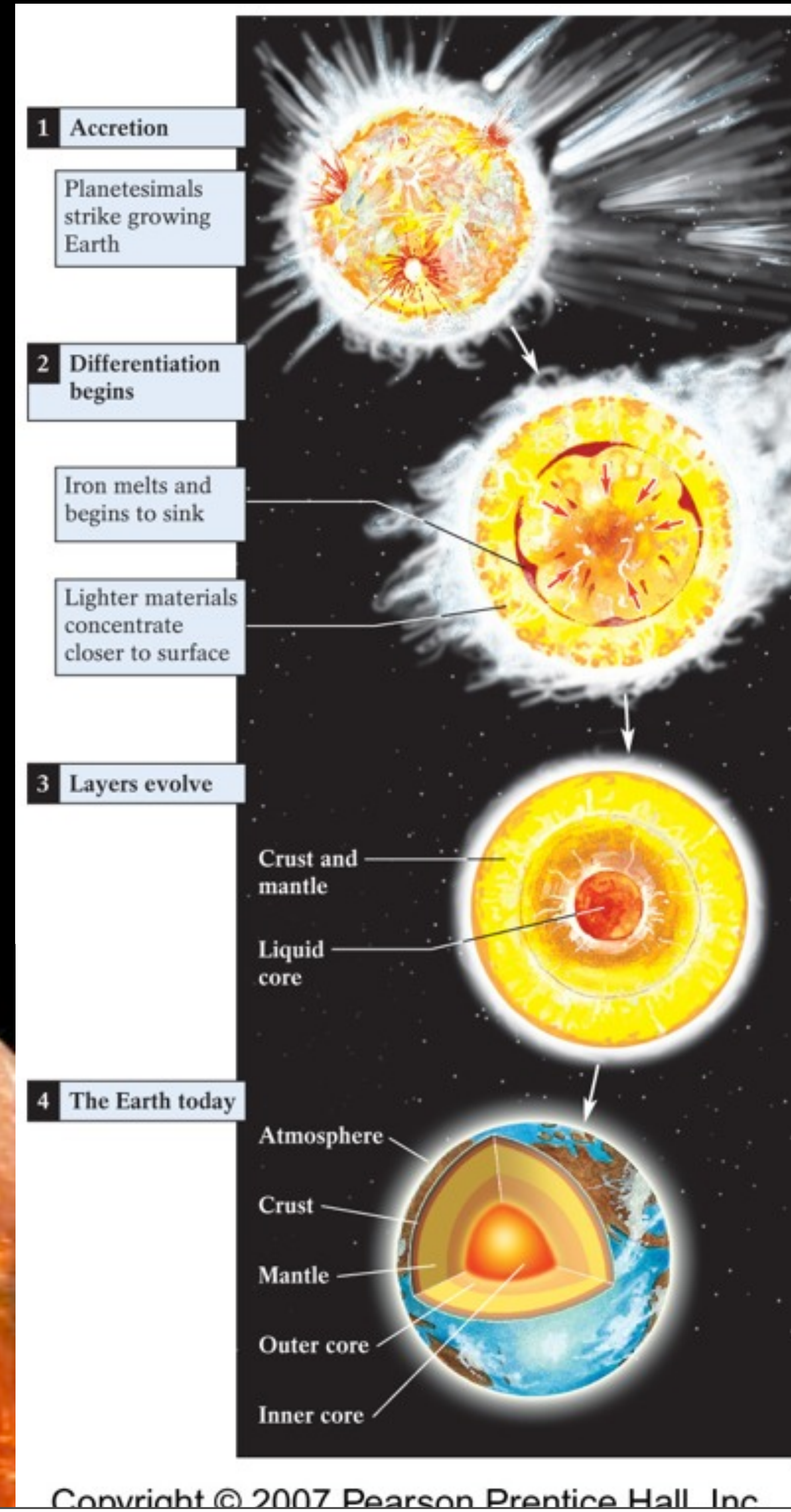
Planetary Formation by Accretion

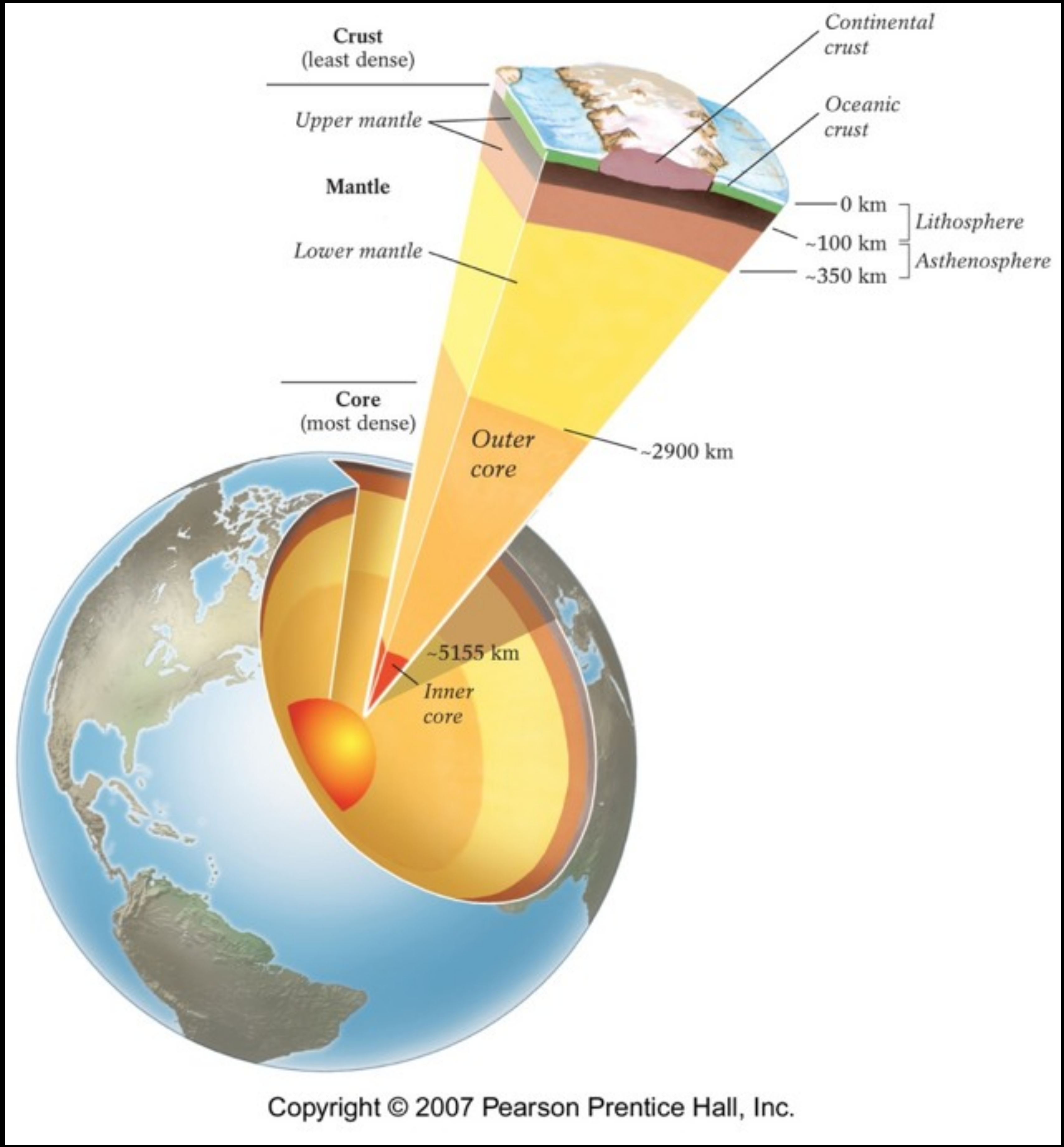
Magma Ocean Hypothesis





Planetary Differentiation

leads to a planet that is <u>compositional</u> layered

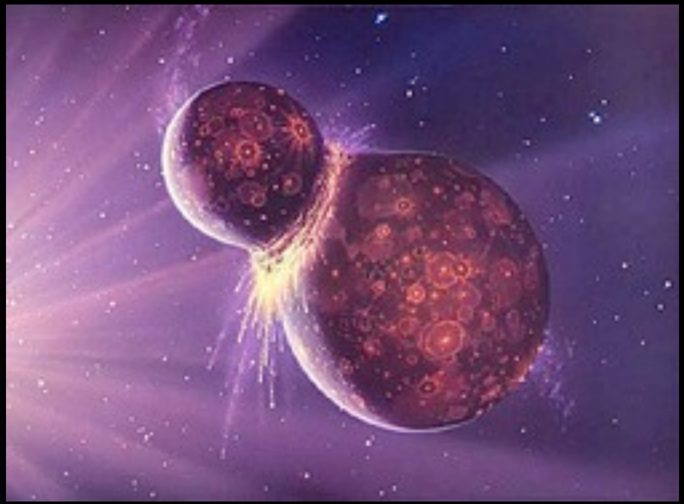


Density and composition of our Neighbors

	Planet	Average Density (g/cm^3)	Composition
Terrestrial	Mercury	5.3	70% Iron - 30% Silicate rock
	Venus	4.4	60% Iron - 40% Silicate rock
	Earth	4.4	35% Iron - 65% Silicate rock
	Our moon	3.4	20% Iron - 80% Silicate rock
	Mars	3.9	25% Iron - 75% Silicate rock
Jovian	Jupiter	1.4	Mostly H, He, O, N, F, S
	Saturn	0.69	Mostly H, He, O, N, F, S
	Uranus	1.27	Mostly H, He, O, N, F, S

You and your group are curious about the the general patterns of the average density and composition of the planets with respect to their proximity to the sun. What are your observations and what hypothesis might they lead you to propose?

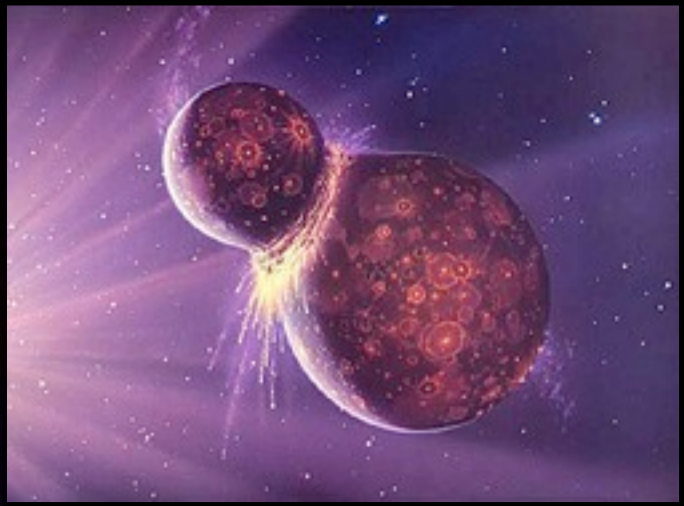
Lunar Formation ~4 Ga



Proto-planet

Lunar Formation ~4 Ga

Interstellar velocities

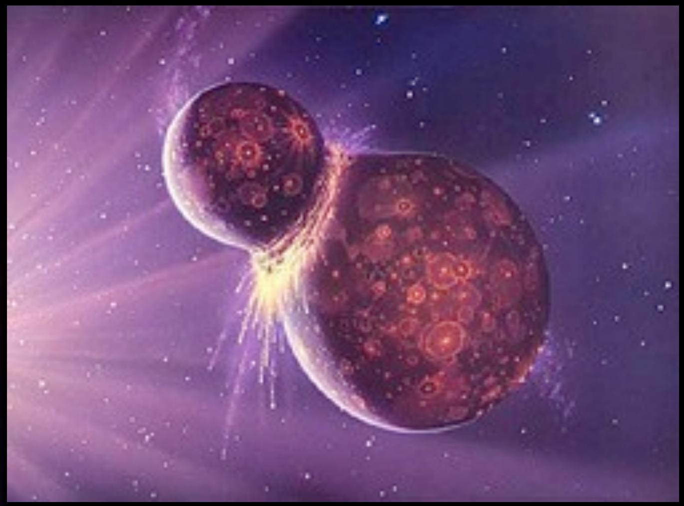


Proto-planet

Lunar Formation ~4 Ga

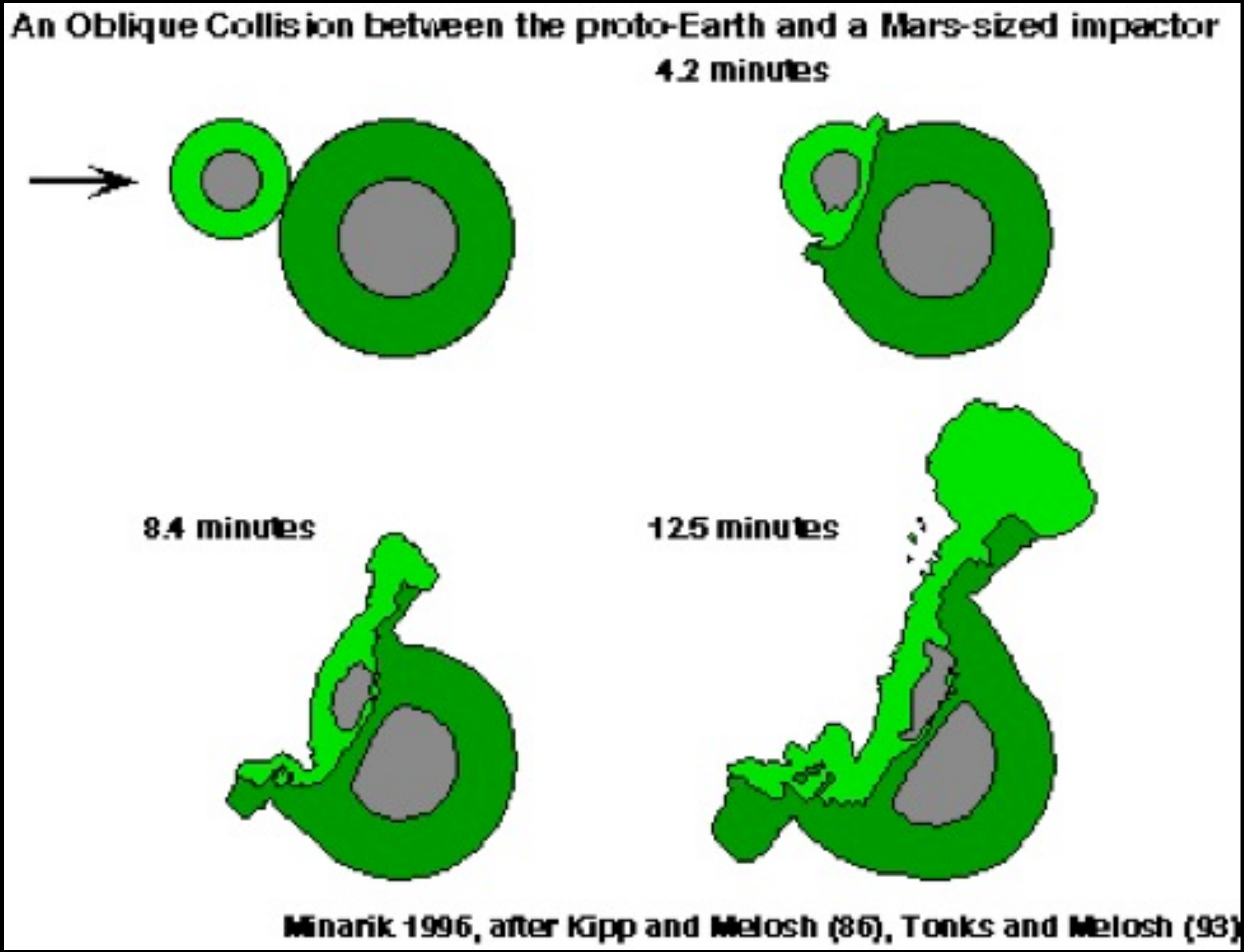
Interstellar velocities

30,000 to 60,000 mph (do not need to know)

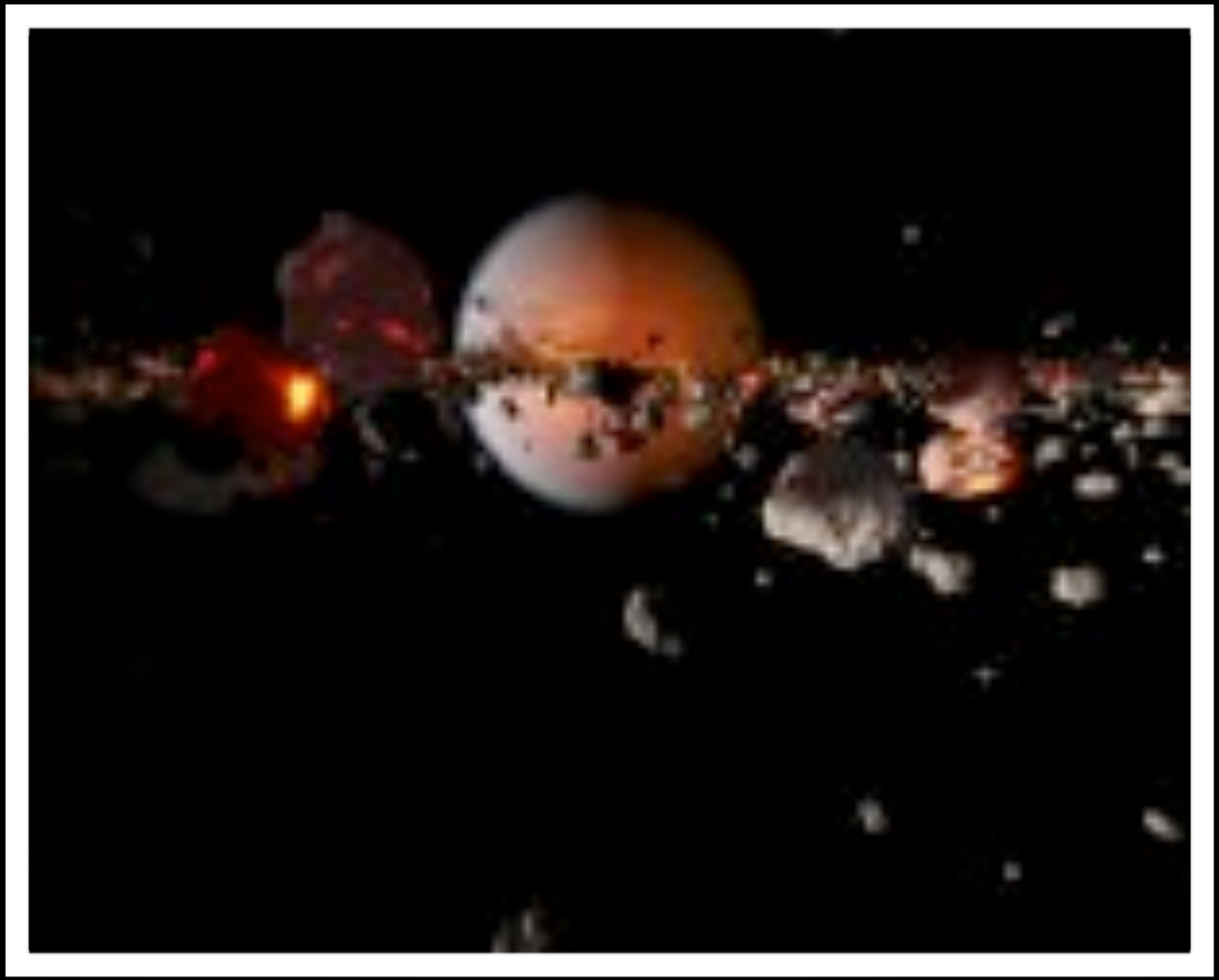


Proto-planet

Time Series of Mars size impactor



Earth with Rings



Formation of the Solar System, Earth, and Moon

http://www.youtube.com/watch?v=_mcC8kFacrk&feature=related

How does our star (The Sun) size up to others in the Milky Way Galaxy

How does our star (The Sun) size up to others in the Milky Way Galaxy

Deductive Reasoning Skills

In your group,
From what we have learned about
the solar system today,
deduce what the the 4 main
<u>compositional</u> types of
extraterrestrial objects (meteors)?

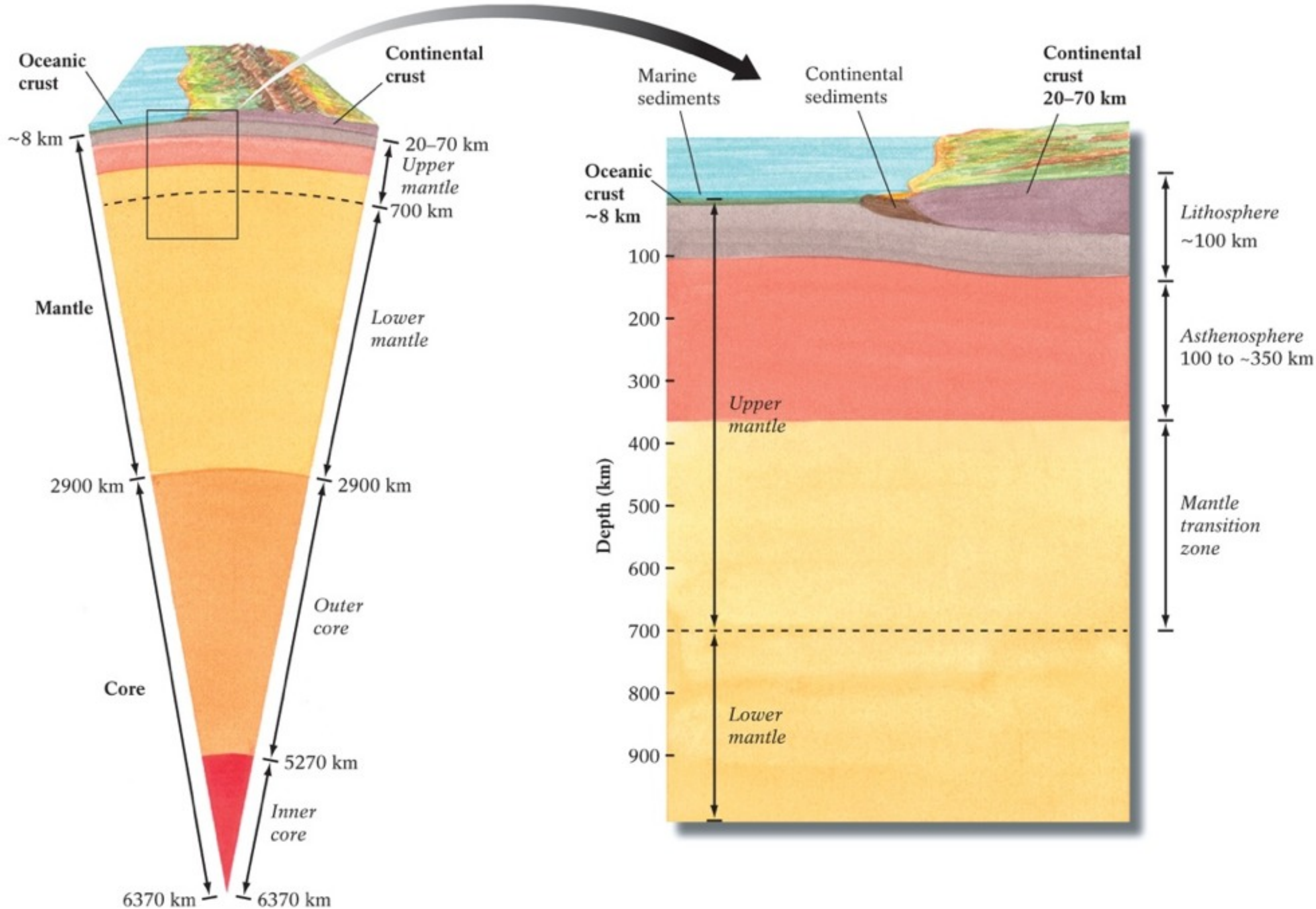
Silicate “stoney” meteorites

Comets (“icy” CO_2, H_2O)

Iron alloy meteorites

Chondritic meteorite

Earths Interior



Earth - Home Sweet Home

Next Quiz

1) Vocabulary Chapters 1a and 11
2) Review Questions Chp 1a and Lecture