

## Cosmic Education: Clock of Eras and the Long Black Line

The Clock of Eras and the Long Black Line are taken from the group “Concept of Time,” which begins with lessons about the calendar year and telling time. Understanding the analog clock is a necessary skill for students to grasp the concept of All Time (or History) represented on a 12-hour clock.

However, there are many ways to teach children to tell time, so the Montessori lessons about time are not essential precedents for the Clock of Eras. I have found it to be a powerful organizer in both Montessori and traditional classrooms for helping students understand the scope of history. It offers them a framework for understanding human’s place in history, often causing them to gasp with appreciation when they “get it.”

Carl Sagan’s Cosmos (and the more recent TV series of the same name narrated by Neil deGrasse Tyson) represents the history of time on a 12-month calendar, with the human story as the last few seconds of the last day of the last month of the year. Similarly the Clock of Eras represents all time since the Big Bang, some 13.8 billion years ago, on the 12-hour clock, with humans showing up in the last half minute.

In addition to providing perspective, the Clock of Eras lesson is an opportunity to introduce the names of the eras, mention the significant events during each, and point out the slim slice of time representing the human story. All using a familiar model, the clock.

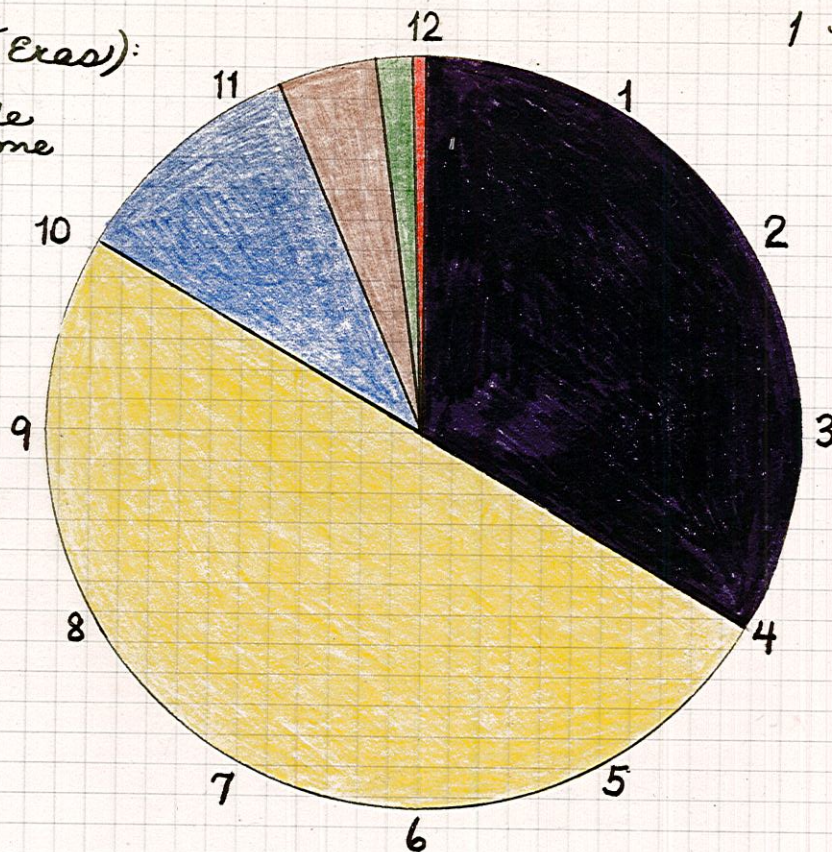
The Long Black Line is another key lesson that might precede the Clock of Eras or be a follow-up, if the material is available. Presented as a very long walk alongside a gradually unrolling line of black felt, the end of the roll is a narrow red strip. The experience dramatizes the brevity of the human story in a visceral way and is especially loved by younger children.



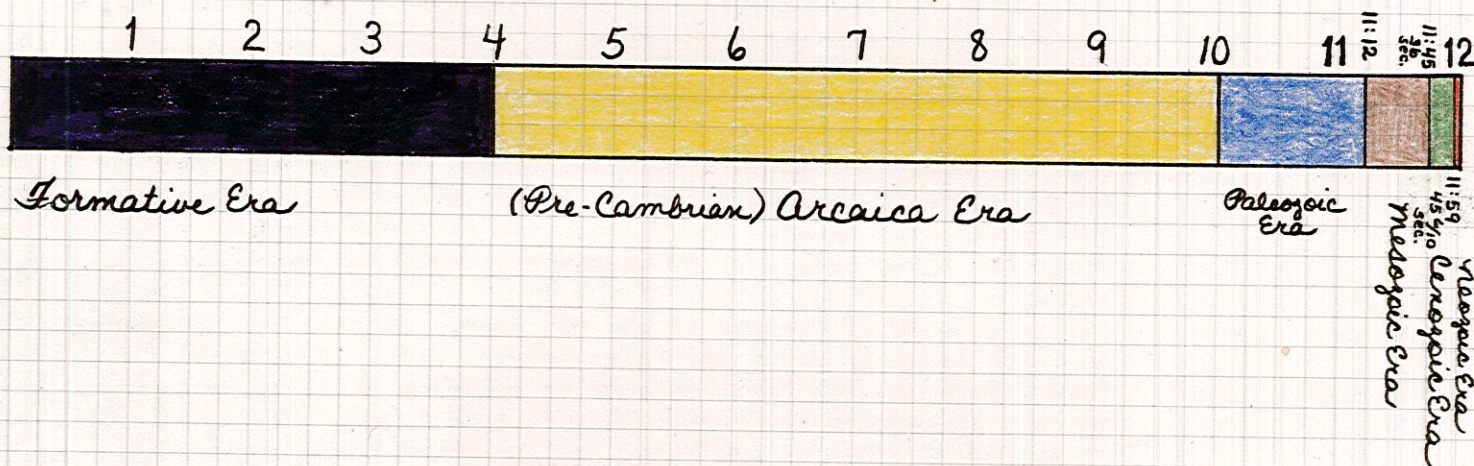
## The Clock of Time (The Clock of the Eras):

the history of the earth from the time it was a mass of gasses to the appearance of man.

1 hour = 250 million years



## The Strip of Time



## THE FORMATION OF THE EARTH

## THE CLOCK OF TIME (Clock of the Eras)

### Materials

1. A clock of time, as shown above---the size of the first hours clock. (cardboard)
2. A second clock, cut into the various color pieces.
3. A series of arrows, on one side of which names the eras and on the reverse gives a brief description, with the essential information to remember.  
OR two sets of arrows, one the label and one the description.
4. The strip of the circumference of the above clock, a narrow paper strip which describes exactly the circumference.
5. The strip of time, as shown above.

### Presentation

1. Show the clock of time.
1. How could this chart tell the history of the earth?



THE CLOCK OF TIME. . .  
Présentation. . .

1. . . . .
  1. .In a day each of the 12 hours has 60 minutes.  
This is a special clock.  
There are 250 ~~MM~~ years in each hour.
2. The children calculate how many years are represented.
  2. How many years are shown on this clock?
3. Using the clock of time and the charts that continue the series begun with the "God Without Hands," briefly describe the eras of the earth's formation:

The Formative Era: During this era, the earth, which began as a mass of gaseous fire, is cooling. Gas particles are escaping in all directions and ascending upwards into the dark and cold. There the gas turns into ice: gas to a solid, and the ice descends to the star surface. It is a perpetual motion --- up and down, up and down, that gradually cools the earth. Chart 3 (angels)

A solid crust is formed with all this ice. But inside the ball there is still gaseous fire that occupies much of the space. And this gas has no way to escape. It is trapped. But resisting this tight enclosure, the gas explodes through the thin crust of the earth in some places and the volcano happens. Chart 4 (volcanoes)

The gas and ashes from these volcanoes forms a cloud which hides the earth. At a certain point, rain begins to fall from the cloud. Because the earth's crust is so hot, when the rain touches the surface, it disappears immediately. (Exp. 20) But little by little, the earth's surface cools; the water begins to remain. Chart 5

This is called the formative era because the earth is transformed during this time from a star to a planet. A star is a gaseous fire; a planet is cold and doesn't give light.

The Arcaica Era: At the beginning of the 4th hour, the earth is formed of sea (water), land, volcanoes; and it is warmed by the sun which at that time was probably hotter. There were mountains, rivers, lakes, oceans; but still no life.

WE DO NOT KNOW WHEN LIFE APPEARED. But sometime during the yellow period of 6 hours, which represents 1,500,000,000 years. It is difficult to be precise about this long stretch of years.

There are no books to describe what happened in this time, but there are some ~~plant~~ remains which have been transformed into stone from this period. They are called fossils and they can help us understand this period. Only a few such fossils have been discovered from the yellow period---those of algae.

The Paleozoic, Mesozoic, Cenozoic Eras: We do know something about these eras because many fossils (animal and plant) have been found which indicate much about the life during this period. FOSSILS ARE REMAINS OR TRACES OF ORGANISMS THAT LIVED DURING ANCIENT GEOLOGIC TIMES AND WERE BURIED IN ROCKS THAT ACCUMULATED IN THE EARTH'S OUTER PORTION, OR CRUST.

NOTE: It is important that real fossils be used during this presentation. Museum trips might be possible to view a wider range of fossil types. Books to illustrate fossils also are useful.

The story of these eras is a long one that another large time line will tell. Geologists provide us with the valuable information we have to interpret the various eras.



NEOZOIC

Eras	Periods (of time) or Systems (of rock)	Epochs (of time) or Series (of rock)	Approx. Time in years Since beg. of each	Physical & Biological
CENOZOIC	QUATERNARY	RECENT (most recent)	50,000	
		PLEISTOCENE	1,000,000	
	TERTIARY	(more recent) PLIOCENE	12,000,000	
		(less recent) MIOCENE	30,000,000	
		(little recent) OLIGOCENE	40,000,000	
		(down recent) EOCENE	60,000,000	
		(ancient recent) PALEOCENE		
MESOZOIC	CRETACEOUS	Rocky mts. Fossils found in "cherty" rock.	120,000,000	
	JURASSIC	Jura Mt. fossils: between France & Switzerland. Sierra Nevada.	155,000,000	
	TRIASSIC		190,000,000	
PALEOZOIC	PERMIAN	First fossils: Russia. First reptiles. Complete insect metamorphosis. Appalachians mts.	215,000,000	
	PENNSYLVANIAN			
	MISSISSIPPIAN	mammals at end of mississippian. Shales with lumps.	300,000,000	
	DEVONIAN	Fish, insects, cephalopods. now squid, chambered nautilus.	350,000,000	
	SILURIAN	4,000 mile mountain range: Scandinavia, E. Britain, Greenland (Caledonian). Land animals: scorpion, millipede. Land plants: Corals.	340,000,000	
	ORDOVICIAN	Sea scorpion (to 50cm. long): predecessor of land scorpion. Graptolites & armored fish both have cords. (Lamprocyon)	480,000,000	
	CAMBRIAN	Green mts. - Canada	550,000,000	

Note: Mountains rising up mark each period.

giant mammals: giant sloth, mammoth, mastodon

alps, Himalayas

Cascade mts.

HEROIC



## HISTORY: THE LONG BLACK LINE

At this point the child should have acquired an understanding of time. We have given him an idea of the length of time with the time line of centuries. Now we must indicate the idea of the age of the earth.

Our presentation springs from an experience that Dottsa Montessori had with Indian children who said, about civilization: "ours is the most important civilization because it is the oldest. It is the oldest thing in the world." Montessori came up with a plan to demonstrate to the children the error of this judgment.

She made a long strip of ribbon 300 meters in length. It was black. The length of it represented the length of time consumed in the formation of earth and the beginnings of life on it. At the very end of the black ribbon was a small white square which represented the time of man, his history. And she explained: "You think that nothing is as long as Hindu civilization, but I want to show you the story of how old the earth is." Two children on bicycles unrolled the long long black ribbon and Dottsa Montessori explained the significance of the white square.

The age of the earth	3,000,000,000
The time of man	1,000,000
The maximum history of man's civilization	10,000
Recorded history	5,000

The long black line which we present for the children has been reduced in length so that:

1 cm.	=	1,000,000
10 cm.	=	10,000,000
100 cm.	=	100,000,000
10 meters	=	1,000,000,000
30 meters	=	3,000,000,000

The Indian children were impressed with this startling approach to an understanding of history and the formation of the earth in relationship to the length of time. Montessori decided it would be a good impression for all children. And so---with our modified long black line, we can still show this dramatic expression of man's small space of time.

**The direct aim of the presentation is to give a moral lesson about humility. The long black line is very long and the short white square that encloses man's history is almost invisible.**

Another interesting comparison is that if one took the height of the Empire state building, 106 stories tall, as the measure of the earth's history, the history of man could be represented by a slim dime on the top of the radial tower.