

18
**Cosmology, Mythology,
and the Timeline of Light**

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Abstract

This article summarizes the pedagogy and resultant insights of children formed when studying an original, integral, and stunningly artistic approach to cosmology, "The Timeline of Light". Through subsequent analysis, relationships gleaned by fifth and sixth grade students from the lessons are seen through Joseph Campbell's four functions of myth—the mystical, the cosmological, the sociological, and the pedagogical. These insights were formed by sixth grade learners over an eighteen year period at the Denison Montessori School in Denver, Colorado, a public magnet school program. Beginning with an explanation of those four functions, this paper moves to an exploration of original and traditional Montessori educational materials, student work and connections with cosmological, Platonic, Jungian, and Big History themes. As such, the paper suggests both an exemplar and initial framework for an integration of those functions as logical, experiential, and pedagogical emergents from upper elementary and middle school aged students while also providing heuristic value for all other developmental levels.

Keywords: elementary education, Montessori, pedagogy.

During the opening moments of the widely popular Public Broadcast series, *The Power of Myth*, journalist Bill Moyers made the following observation of a shift in meaning made by master mythologist Joseph Campbell: 'You changed the meaning of myth from the *search* for meaning to the *experience* of meaning' (Campbell and Moyers 1988: 5, author's italics). Certainly this shift is essential for adults, but perhaps even more so for elementary and middle school aged students. It is equally essential as a context and goal of my work with children and cosmology via the Timeline of Light activities. Children should *experience* meaning.

This paper derives its authority and authenticity from the experiences of 11 and 12 year old children in my upper elementary classes at the Denison Montessori School, a 460 student public magnet program in Denver, Colorado. In short, the children like those experiences and their subsequent insights. It also assumes Brian Swimme's definition of cosmology (Swimme 1996: 31) as both primary and meaningful: 'Cosmology,

Teaching & Researching Big History 336–346

though it is consonant with science, is not science. Cosmology is a wisdom tradition drawing upon not just science but religion and art and philosophy. Its principal aim is not the gathering of facts and theories but the transformation of the human'.

Originally designed to fill a relative void in the Montessori approach – the history of the universe and planet prior to the Cambrian period – the approach has been presented locally and nationally at Montessori, holistic education and environmental conferences and workshops.

The work was initially inspired by Brian Swimme and Thomas Berry's (Swimme and Berry 1992) *The Universe Story: From the Primordial Flaring Forth to the Ecozoic Era: A Celebration of the Unfolding of the Cosmos*, a remarkably integral history of our universe and our planet. Not only was the information new when I read it in 1993, but so was the perspective. Both authors insisted on a unique grammatical and ontological perspective: the reader, the author, indeed all of us, are the universe acting. This switch from the typical subject-object relationship was a shift of considerable proportions, a shift made both implicitly and explicitly throughout *The Universe Story*. For a Montessori director, *The Universe Story* clearly was a compelling addition to what Montessori called the idea of the universe (Montessori 1948), a notion that has a distinctly cosmological, trans-disciplinary and integral core. Since Montessori's death in 1952, there have been numerous scientific accretions to cosmological understanding. *The Universe Story* summarized and, more importantly, contextualized many of them. Furthermore, it addressed one of life's pressing questions, a question of which Montessori was well aware, 'What am I?' (Montessori 1948: 10), a concern very similar to the heart of Big History, 'Who am I?' (Christian 2004: 1) and the central concern of Montessori's enterprise as seen by Montessori educators and authors, Michael and D'Neil Duffy (Duffy M. and Duffy D. 2002: 4), with all seeing the question in both variations as central to a life well lived. However, rather than answering the question through a singular mode or perspective, Montessori envisioned an integration of the sciences and humanities as part of a grand cosmic story or plan (Montessori 1948). For Montessori, the perspectives gained from an interdisciplinary approach provided the context for all disciplines and explorations. Not so oddly, her pedagogy is in harmony both with Joseph Campbell's approach to the functions of myth and David Christian's vision of Big History as a 'modern creation myth' (Christian 2004: 6).

Campbell saw myth addressing four human functions (Campbell 1986: 31): the mystical, the cosmological, the sociological, and the pedagogical. Myth therefore functions in all aspects of human experience.

The first, the mystical, opens the participant to enter into a realization of what a wonder the universe is, 'Myth opens the world to the dimension of mystery' (*Ibid.*). Campbell's second function, the cosmological, embraces and magnifies the domain of the empirical sciences, 'showing you what the shape of the universe is, but showing it in a way that the mystery comes through again' (*Ibid.*). The third, or sociological, function validates a certain social order; and the fourth, the pedagogical function, is that which instructs, 'how to live a human lifetime under any circumstances' (*Ibid.*). The mythic and cosmological functions are primary, said Campbell, for they are central to establishing a sense of awe and wonder of opening 'mind and heart' (Campbell 1988: 18) and as presenting nature as an 'epiphany' (*Ibid.*). The Timeline of Light activities are intended to arouse the sense of wonder and awe inherent in the mystical and cosmological functions that Montessori and Campbell so highly valued, while simultaneously addressing the sociological and pedagogical functions.

Montessori took the direction of education one big step into the cosmological dimension when she established the story of the universe as central to her now world-famous approach to elementary education. Writing in 1948, she claimed (Montessori 1948: 9), 'If the idea of the universe be presented to the child in the right way, it will do more for him than just arouse his interest, for it will create in him admiration and wonder, a feeling loftier than any interest and more satisfying. The child's mind will no longer wander but can become fixed and do work'.

The following affords a brief sketch of how Campbell's four functions are welded into the Timeline of Light approach in a Montessori classroom and thus suggests an exemplar for the mythic functions as a truly integral pedagogical approach to the versions of experience that Montessori, Swimme, Campbell and Christian champion. Consequently, it affords an initial framework for Big History at the elementary and middle school levels while providing heuristic value for all of life's other developmental stages.

Context

Before beginning, let us look at the broader context and content of the activities. The initial approach utilized 18 lessons, presenting cosmological principles through an integration of art, story, drama, mathematics, geometry, experimentation, brainstorming, poetry, and song. Thus it follows the cosmological visions of both Montessori and Swimme. While the following presentation highlights some of the earlier and therefore more foundational lessons, it does not and cannot detail the entire framework of activities and images.

The timeline itself is a striking visual presentation of the universe story as seen through my imagination and drawn by artistic friend Tim Hogan. The actual classroom timeline is a 9 feet long, 20 inches wide material and quite striking in color.

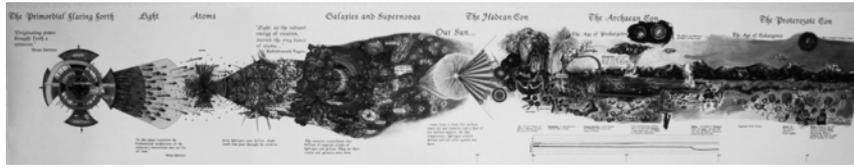


Fig. 1. The Timeline of Light

Regardless, children do not traditionally see this interpretation until, guided by their own activity and experience, their personal story and images have begun to form, usually 11 weeks after the introductory presentation. Prior to that time the children hear stories and respond artistically, complete mathematical and geometric tasks, sing songs and have lessons introducing primary cosmological concepts: the relative size of a hydrogen atom, supernovas, stellar size, and distances between the Milky Way and our nearest neighboring galaxy. All of these concepts are then integrated in the visual presentation of the timeline. The timeline is therefore a visual presentation of a creation myth showing and suggesting all of Campbell's four mythic aspects with which the children have become familiar. Thus, the timeline's imagery and content provides a series of points of departure for various lessons, explorations and researches into geometry, chemistry, astronomy, biology, and other intellectual disciplines.

The Mythic Functions

Jungian Anthony Stevens (Stevens 1993: 63) affords a remarkably clear and concise definition of origin myths 'as an account of human origins that accords with the knowledge prevailing at the time of the myth's emergence into consciousness', a definition compatible with Campbell's definition of mythic functions, Christian's Big History, Swimme and Berry's definition of cosmology and Montessori's vision of cosmic education. Far from myth as a preliminary to science, this definition assumes current science as integral to mythology. Christian provides an important complement to Steven's definition with a simple and important reminder (Christian 2004: 11), 'In their day all creation myths offered workable maps of reality, and that is why they were believed. They made sense of what people knew'. All of the foregoing thinkers are

united in their desire to have children and adults know that we are now able to make numerous new connections. Contemporary cosmology, therefore, provides content for an emergent more internally cohesive and participatory map of reality.

The Mystical Function

Why is there something rather than nothing? Its corollary then leaps out: How, exactly, did that happen? That is *the* mystery of creation mythologies. Imagine your eleven year old self, sitting with a small group invited – in the grand tradition of ‘once upon a time’ common to children throughout spoken history – to explore the mystery.

It is impossible to imagine nothing at all and impossible to imagine a time before time. The great mystery of creation, the time when time began, has called throughout the ages wherever great thought occurred. This mystery is ever with us, ever challenging us to look more deeply into life's well of experience in hopes that we, like some likely prospector, find the gold we speak (Fowler 2000: 49).

Through this type of invitation and subsequent introduction children are called to the great questions and their possible solution *as if they matter*. Montessori saw the import of this open-ended approach to discovery and wrote (Montessori 1948: 7), ‘No matter what we touch, an atom, or a cell, we cannot explain it without knowledge of the wide universe. What better answer can be given to these questers of knowledge?’ In a world trivialized by the media and diversions too numerous to count, children at Denison have leapt to an opportunity for deeper contemplation, as if to say, ‘Wow! You thought about this stuff, too?’ and thereby establish a deeper rapport and communion with their life, their universe, and their teacher. After hearing an integrated mythic/poetic/scientific story of the creation of the universe, children have responded both artistically and verbally.

The children frequently comment that the story and the setting create a feeling of life, of a living universe of which the children are part, and a desire for more. ‘I realize how important it is to have life... the music created a feeling of life’, said Alondra (Fowler 2000: 60–61) and added that she desired more. ‘I felt desperate for more. I don't know what it is that I wanted. I just wanted. I was just desperate’. In that same vein, Monica once offered, ‘I feel relaxed, surprised and incomplete. Relaxed from the music and the darkness, surprised how you said it and the fact that I didn't know, and incomplete because you didn't finish the story. Can we do it again?’

These youthful utterances are strongly suggestive of an awareness at least as old as Plato's eros as detailed in the *Symposium*. The distinguished Oxford Platonist, Francis Cornford interpreted eros as 'the single force or fund of energy' (Cornford 1967: 71), whose objects range from the sensual to the good and the divine. Certainly the children's desires suggest Swimme's allurements – the attraction... the birthplace of philosophy... philo-sophia, the love of wisdom; furthermore, 'love begins as allurements... as attractions' (Swimme 1984: 45), Swimme's Thomas says to a star struck youth. If children do not have that love of learning, that desire for more, there is little reason to go on other than obedience and an adherence to the do-good stereotype, a posture which, after 30 years in the classroom, seems a poor substitute for that love offered by Diotima in Plato's *Symposium* and the allurements suggested by Swimme's sagely Thomas.

The last and in many ways the most striking evidence of the mystical function offered here is Julio's, a child of modest background, whose summary of his initial experience has stayed with me for well more than a decade. It is particularly noteworthy that he was not a particularly religious child when he said, 'I felt like I was there when the universe was being born. And I felt like I was born again at that very same time' (Fowler 2000: 62).

The Cosmological Function

Campbell's cosmological function rests iron dense at the timeline's pedagogical core. It is essential that children *experience* 'the shape that the universe is, but [by] showing it in a way that the mystery comes through' (Campbell 1988: 31). For example, let us explore a hydrogen atom. Shortly after telling two stories of the creation of the universe and the formation of galaxies and hence, but briefly, quarks and the first hydrogen and subsequent helium atoms, the children are invited to physically walk through the dimensions of a hydrogen atom on our school's baseball diamond. Here is a description of their *experience*, originally modeled on Packard's description (Packard 1994: 115–117).

The children are led outside with barely a spoken word. A grain of sand is dramatically gathered, examined, and placed on a red bandana on top of the home plate of our baseball diamond with, again, barely a spoken word. We then begin a slow walk away from the grain of sand, maintaining silence or at least quiet while slowly walking an approximate radius and then arc using that grain of sand as center of our invisible closed curve. The group pauses where the actual radius begins some three hundred feet away from the grain of sand, approximately

the length of a football field. As we walk in that silence the children have a chance to experience space. Occasionally I look curiously and longingly back towards that very soon invisible grain of sand.

After we have reached a point some three hundred feet distant from our now invisible center, the children are told, 'That center is the nucleus of a hydrogen atom, the first atom formed in the history of the universe. We are as far away from it as an electron would be (and I pick up the smallest available particle of dirt) in a hydrogen atom is from its nucleus. It orbits at this distance, more or less, in all directions' and I point up down and at all manner of varied angles. 'The question is ... how does the electron know where to go?' This always provokes a variety of answers, but they always seem to center on a type of communication between the two tiny, nay invisible, sub-atomic particles. The key point, however, is the great mystery that atoms, which underlie all that we see, feel, touch, taste, smell, and hear, are so full of empty space. This impressionistic introduction helps the children begin to understand the construction of the physical cosmos as both a way that the mystery Campbell described, and the wonder that Montessori predicted, is fueled. A subsequent story/lesson helps them realize that even though atoms themselves have never been seen but their effects have been recognized.

The Timeline of Light approach is also rife with mathematical challenges and concepts. The notion of infinity, so central to cosmology, is introduced geometrically, when the children construct models of infinity within limits, a standard geometric approach within the Montessori Method as indicated in the following charts.



Fig. 2. Art by the author

The first image of infinity within limits is a simple construction, effected by bisecting the side of a square and then connecting the mid-points in successive fashion. Fig. 2, the above middle chart is a construction that involves the bisection of the side of a square and then a line segment equal to the length of the side of the original square used as both diagonals of the resultant next square. The final chart utilizes an extension of the previous principal into a potentially infinite progression. The experience of constructing these patterns is very engaging and meaningful to the children.

In addition to these geometrical constructions, the approach also uses mathematical problems to determine the approximate age of the universe, the appropriate exponential expression for the time it takes a photon to cross the nucleus of an atom and the range of their teacher's age expressed as a function of the same. Here is a sampling from a challenging set of questions (Fowler 2000: 100-101):

1. The universe is only seconds old, approximately 10^{18} seconds old. How many years old does this make the universe?...

5. Many of you have asked me how old I am. Well, I won't be exact but I am older than 10^9 seconds. How many years is that?

7. At the other extreme we have the very large. The largest distance we can presently calculate is the radius of the universe. As you can see, the general belief is that the universe is round, like a giant sphere. We take the radius to be 10^{28} centimeters. How many meters is that? Kilometers? Miles?

Discovering the macro and micro principles and aspects of the universe in this way is both challenging and exhilarating and the children love it, even though not all children answer all of the problems correctly. Nevertheless, the search for the fruitful approach is indeed half of the challenge and the children learn greatly through the process.

In addition to a mathematical emphasis, various properties of light are explored, reflection, refraction, the inverse square law for change in surface coverage, and an initial classification of the chemical elements. While story and experiment are used, both are made contextualized in the universe, and thereby made more relevant and interesting because they are part of a much larger process that strikes the imagination's ability to wonder.

The Sociological and Pedagogical Functions

These two points of consciousness are implicit throughout the course of demonstrations, questions, projects and activities, and derive their strength from both the mystical and cosmological dimensions. As the timeline's imagery and activities address the first 3.6 billion years of

earth's history, the following cosmological and biological points are made clear: 1) the universe comes from *light*, a declaration rich in marvelous scientific, literary, and poetic connotations; 2) vis-à-vis the primordial act of photosynthesis, that light is captured and serves as *primal food*; 3) the bacteria that utilize that food *cooperate* with each other and their environment at a phenomenal rate and degree, sharing their collective memory through DNA transferred from bacterium to bacterium when in close proximity; 4) and, finally, because of that cooperation they evolved, shared, *created complexity*, and eventually transformed their non-nucleated bodies into a nucleated one which allowed for increased growth and communal richness through a diversity greater than possible at the previous bacterial level of organization. This and other examples of cooperation and diversity provide ecological and moral guidelines as these characteristics are presented and seen not merely as human constructs but as patterns necessarily inherent in the evolution of the planet.

So throughout the five or so months of lessons and activities stemming from the timeline, certain sociological and pedagogical implications become ever clearer. If humans follow the path of the universe and the planet of which we are part, it seems wise to cooperate whenever possible, share to the greatest possible degree, and utilize the collective wisdom of the entire cosmological process and learn from the diverse processes which have been essential to the emergence of life on our planet. Accordingly, the societal and the pedagogical merge. The now cosmologically aware child becomes an embodiment of an expanded and better understood idea of the universe, the planet, and its relationships.

A very short story and a child's poem highlight a possible outcome of this process. The story told to the children is entitled 'The Sacrifice of the Sun':

Each second the Sun gives away four million tons of its helium for light and energy. It has been giving away almost this much for nearly all of its 4.6 billion years life! Our planet uses this radiant energy as the essential stuff of life, the food for photosynthesis. We store it in our bodies and honor it in the glory of each new dawn. This incredible give away of the Sun is at the very center of our life on earth. Without it we would not be here.

Inspired by this brief message, Tara responded with a theme seen frequently, but seldom so poetically, over the years. Let her words conclude the body of this text.

The Giver

Light
Expanding, Radiant,
Rushing, Giving, Receiving.
It burns in all of us,
The Giver.

Concluding Thoughts

Other connections, other thinkers, can easily be drawn into this tale, to support and amplify its messages. Ken Wilber, Jungian archetypes, Einstein, Charles Darwin, great poets *à la* Whitman, come first to mind but surely there are so many more. All of them follow as an easy deduction, for after all, this work is about the creation of everything.

As such, it is, as creation mythologies have always been, both psychologically and scientifically, a starting point, and a door to understanding experience. More importantly, as Tara's poetic insight suggests, there is reason for hope that this timeline will serve the primary integral function of mythology as described by Campbell, 'Indeed the first and most essential service of a mythology is this one, of opening the mind and heart to the utter wonder of all being' (Campbell 1986: 18). That experience has always been a great place to start any exploration or path of discovery. To explicitly or implicitly offer experiences that lead to the union of mind and emotion, is a goal of all true mythologies, all big stories which have shaped cultures and epochs in both conscious and unconscious ways. Then, once both mind and heart are engaged, a new focus can be attained. As Montessori proclaimed, 'intelligence can become whole and complete because of the vision of the whole that has been presented to him, and his interest spreads to all for all are linked and have their place in the universe on which his mind is centered' (Montessori 1948: 9). Hence, a mythology that goes beyond the local folk ideas and into the cosmic idea suggested by a non-sectarian scientific perspective can take both a cultural and psychological center stage. 'The principle can now, however, be developed on a scientific plan and be made far more attractive'... 'modern and complete' (Montessori 1948: 10). Hence, the promise of myth, the pedagogical vision of Montessori, the modern cosmological insight, and the direction of big history now have a model and a common point of light from which to depart.

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