The Cosmic Walk: The Spiraling Story of Our Universe

created by Rabbi David Seidenberg, based on the work of many many others

For the Leader or Narrator:

This is a telling of the story of the Universe according to current science, as a sacred story that fits into our religious traditions. It was created by Sister Miriam MacGillis from Genesis Farm, and further developed by others in the eco-spirituality movement. This version was written by Rabbi David Seidenberg (who first learned it from John Seed), and it includes many new details about religion and science, including information about paleogeography and continental drift. As a Jewish telling of the story, this version also includes specific references to the evolution of Judaism, and it structures the telling according to the "seven days of creation" which, according to Kabbalah, are actually the seven lower Sefirot, the qualities through which God created the world. The spiral rope used for the walk represents 13.7 billion years of this unfolding story. One eighth of an inch equals about one and a half million years; ten feet equals about one and a half billion years. (Part of this paragraph is repeated on page 2 for the actual storytelling.)

There are 30 stations, some of which include multiple events, divided into seven "days". Alongside each station you will find measurements for how far one travels on a 100' rope, corresponding to the 13.7 billions years since the Universe began. When you set up the rope, measure each distance from the previous candle junction and mark it with tape or marker. (For 100' rope: 10' ~ 1.5 billion; 6.5' ~ 1 billion yrs; 1' ~ 150 million years; 1" ~ 12.5 million years; 1/8" ~ 1.5 million years. Bya = billion years ago; mya = million years ago.) A rope ½" thick works best because it will lay out smoothly. If it's windy or you're in a space where fire can't be lit, battery "candles" work just as well. At each station place a tea light candle. The telling of the story goes like this:

1) The narrator reads (or improvises) a description of each station (including any events labeled a, b, c).
2) The candle lighter waits until the narrator is finished, then lights the candle at that station.
3) The candle lighter then walks slowly to the next station and stops.

This process repeats until the end. All of the last stations, represented by letters instead of numbers, correspond to the final candle at the end of the rope. You can do a simpler, shorter ritual by just reading what is in bold, or a longer, more technical one by reading what is in parentheses. Much of the parenthetical information is given in order to deepen the leader's understanding of these events; there is more scientific information here than is needed for the average audience. Use your discretion in deciding what to improvise, what to include, and what to leave out. If you're not sure what to do, or if you don't have time to decide exactly what parts you will read, then ***just read what is in bold*** *(or use Version II). Feel free to edit the long version to include just the parts you want to emphasize. If you make significant changes, please state that the ritual is "based on" the script created by neohasid.org.*

Notes: 1) The dates for various stations are approximate, and are given according to the most widely-accepted opinions, as best as the author could determine. The order of events is fairly well-defined, but dates and even the order of some stations are debated, can vary, and may not reflect the most recent theories. The Cosmic Walk story will in any case change as science develops.
2) The events related in the story focus on the emergence of mammals and humans. A Cosmic Walk told from a fish's perspective would be quite different in emphasis.
3) The paleogeologic names given to different time spans, as well as the paleogeographic names for continents, are given to make it easy to do further research. Use them in the telling only if it enhances the experience of participants.
4) An eon is the largest division of Earth-time (also sometimes called an era). An eon is made up of eras (confusingly) or ages; an era or age is made up of epochs or periods—below the terminology used is eon/era/period. This terminology can vary from one book or site to another. If you include the names for these divisions of time, use whichever terminology sounds best to you.
5) Three verbs are used to describe the formation of new species: appear, emerge, and radiate. 'Appear' refers to the earliest known instances of a kind or species in the fossil record; 'emerge' refers to the time when a class or species becomes established; 'radiate' refers to the time when a class or clade of species evolves to fill many different ecological niches.
6) Many versions of the Cosmic Walk, including the ones that formed the basis for this version (esp. Edwards, Rosenhek and Bernuy versions), can be found at:

http://www.threeeyesofuniverse.org/public/cosmicwalks/TheCosmicWalk.html

Version I. **The Cosmic Walk is a telling of the story of the Universe according to current science, as a sacred story that fits into our spiritual and religious traditions. It was created by Sister Miriam MacGillis** (from Genesis Farm, and further developed by the eco-spirituality movement). **This version is** written by Rabbi David Seidenberg **from neohasid.org.** It includes many new details about religion and science, including paleogeography and continental drift. As a Jewish telling, this version also includes references to the evolution of Judaism, and **it structures the telling according to the "seven days of creation" which, according to Kabbalah, are actually the seven lower** Sefirot, the **qualities through which God created the world. The spiral rope you see represents 13.7 billion years** of this unfolding story. One eighth of an inch equals about one and a half million years; **ten feet equals about one and a half billion years.**

The symbol of the spiral is fundamental to the experience of the Cosmic Walk. **When the story of the Universe is told in science museums and textbooks, time is often represented by a straight, very long line, with the whole of human history being only the tiniest sliver at the very end, visually** (and spiritually) **separated from the rest of history by whatever happened just before us.** The implied message is that we are an insignificant coda to a vast but unconscious story. **In contrast, as we walk the spiral, the beginning is visible from every point; we stand in relation to the whole story at all times. Similarly, we are taught that our solar system is one of billions and trillions of specks in comparison with the whole of the Universe. But if there is only a one in one billion trillion chance of life beginning on a planet like ours, then a billion trillion such planets might be created in order for life to evolve! The vast magnitude of the Universe may be the precondition for life to exist. All of these miracles, exactly as they happened, were needed in order for us to be here. You are invited to be a witness** to this story, **and to experience gratitude, awe, or any other emotions that arise. At the end of the telling, you can** sit silently, or **walk the spiral. After a few minutes of meditation** following the story, chanting, dancing, drumming and **all kinds of celebration are welcome!**

In the beginning… We begin with what we call 'The Big Bang'. In Kabbalah, we begin with *tzimtzum*, contraction, followed by Love.

Chesed—Love: expansion through love, free energy created out of nothing, the revelation of light.

1. **The Great Emergence, 13.7 billion Earth years ago. *Yesh Me'ayin*, something from nothing, *creatio ex nihilo*—no words we have can describe what happened. A constriction to a point, or contraction away from a point—in Kabbalah, *tzimtzum*, creating a womb-space for the first light, the *Or Haganuz,* the hidden light, or *Or Ein Sof,* the endless light.** *Tzimtzum* draws forth the primordial light from nothingness into emptiness, **drawing the Universe into** what we identify as **extraordinary inflation and expansion** (from 10^{-32} to 10^{-12} seconds). (The expansion is **propelled by dark** or "vacuum" **energy**, truly hidden "light".) **Quarks**, (gluons, photons, and electrons) precipitate or **emerge from the ether** (or the "quantum foam") **pulsing, exploding, with energy**. As fundamental symmetries are broken and energy and matter decouple, entities and forces are separated from each other by infinitesimal divergences. **3 minutes after the Big Bang quarks have formed into protons and neutrons** (a process called 'baryogenesis'). **13 minutes after the Big Bang, the Universe is filled with 75% hydrogen nuclei and 25% helium nuclei** by mass—(nuclei with 1 or 2 protons plus neutrons). (Traces of lithium and beryllium also appeared.) **A beginning filled with all promise of whatever was and whatever will be.** Beginning of rope
2. **380,000 years later, the Cosmic Web emerges.** (Some people think this happened at 700,000 years.) As quarks lead to protons so protons lead to atoms. **A burst of radiation is released as the seething plasma—protons, neutrons and electrons—cools enough to combine to form atoms**, mostly hydrogen and some helium. **This burst of light, traveling through billions of light years, is the cosmic microwave background radiation** (CMB) **that we can still see today. Minute differences in the distribution of matter** ("anisotropies") **allow gravity to start pulling the primal elements and particles together, leading hundreds of millions of years later to the first stars. Afterwards, the Universe, though filled with light, becomes opaque**, because the newly formed hydrogen (through absorption and reemission) changes most light passing through it. 1/32"—candle goes next to the first one
3. **200-400 million years later** (= 13.5 bya), **primal stars emerge**, different from han any that exist now**. Created in a world almost devoid of what astronomers call "metals"—elements heavier than helium—these stars may have been hundreds of times larger than the sun. Over millions of years, these stars and their descendants reionize the interstellar hydrogen, making it transparent again.** Inside these primal stars (called Population III stars), new elements are created ("stellar nucleosynthesis") which will allow the variety of stars we see today to emerge (blue giants, red giants, yellow stars, white dwarfs, etc.) 1.5'
4. **300 million years later, galaxies emerge, made up of vast systems of stars** (called Population II stars). We can see what some people believe are these first galaxies. These newer stars begin creating the carbon (through the triple-alpha process that fuses three helium nuclei), along with the oxygen and nitrogen (through the CNO cycle), that ultimately become the foundation for organic life. It will take billions of years for enough of the heavier elements to exist for the Universe to create stars with more "metals"—like our sun (Population I stars). 2'
5. Some **two and a half billion years later,** (10-11 bya) **some people believe that dust in interstellar space, made up of elements** like carbon, oxygen and nitrogen that were **created inside older stars, could have produced the first "organic" molecules.** 17'

And there was evening and there was morning, one day.

Gevurah—Might: creation through limiting, shattering, destruction. Our planet is born.

6. **4.6 billion years ago (5.9 billion years later), the birth of our solar system. Millions or billions of years before, our grandparent stars died as supernovas, sending forth new matter which now forms planets and asteroids; a surrounding cloud of hydrogen collapses to ignite as our Sun. Every atom on earth and in your body is older than the Sun; every one besides hydrogen was created inside a star.** (Every atom heavier than iron was created by a supernova.) This is the solar system, the beginning of our unique history, our corner of the Universe, evolving along its own path, different from every other place. **Earth is born.** (We know there are other stars with planets too, other "solar systems", each with its own unique history. We do not know if any other planets support life.) 41'
7. **4.3 bya, the Hadeon Eon. The gravity of the outer planets sweeps debris left over from the creation of the solar system into a collision path with Earth** and the other inner planets**. One of the greatest collisions creates the moon** when a planetoid is vaporized by its impact with the Earth and thrown into space, along with a tremendous mass from the Earth (while its core becomes part of Earth's core). (Some people think it may have taken the moon only a few hundred thousand years to form after this event.) **The Earth-Moon dance, and the tilt of the Earth, which gives us tides and seasons, are created. The tides will encourage life to move onto land millions of years later, and the seasons will allow life, once it is on land, to exist all the way from the equator to the poles** (though the current configuration of continents that stretches nearly pole to pole is only about 90 million years old). **At the end of this time, comets of ice also strike the Earth, bringing all the water that will create our planet's oceans.** (Water may have existed on Earth before this, but if it did it would have been driven off at the beginning of the bombardment.) 2'

And there was evening and there was morning, the second day.

Tiferet—**Balance and Beauty: the intertwining of expansion and restriction, which leads to dynamic growth, death and birth. Earth comes to LIFE!** And ultimately, to consciousness. (No one knows for sure if other corners of the Universe have undergone similar transformations, but many people believe that the conditions for life to evolve must exist elsewhere too.)

8. **3.9 bya, the Archaeon Eon, life emerges, in mystery, through perhaps unfathomable processes. The first cells, ancestors of archaea or bacteria** (both prokaryotes without organelles), **replicate in the oceans** and live by chemosynthesis without sunlight. (We don't know whether the first life was based on DNA, RNA, or some other configuration. Most life which we see now—except some viruses—is based on DNA.) (Some people believe that archaea were the first organisms.) 2' 8"
9. **3.5 bya, Bacteria split off from Archaea.** (The main differences between bacteria and archaea are hard to visualize. Many species of archaea live in extreme, e.g. very hot or very acidic, environments, and so are thought of as "extremophiles"; most are anaerobic; none photosynthesize. Archaea are in many ways chemically more similar to eukaryotes—animals, plants and fungi—than to bacteria.) 2' 8"
10. **3 bya, cyanobacteria** (or "blue-green algae") **invent photosynthesis. Earth learns to feed on sunlight! Millions of years of photosynthesis** will **create a new atmosphere filled with oxygen – poisonous to most of the life that existed then**, but essential for the metabolism of the plants and animals that will eventually colonize the land. (Some say that this happened in as little as 300,000 years, and that photosynthesis was invented 2.8 bya. Some say photosynthesis was invented 3.5 bya and that it took 1 billion years for the oxygen atmosphere to form.) (Red banded-iron formations created during this time show that Earth maintained her equilibrium for millions of years by absorbing the freed oxygen.) There was most likely a mass extinction of anaerobic life forms (cells that live in the absence of oxygen). (The advent of an oxygen atmosphere may have also led to a "snowball earth" because of the destruction of many greenhouse gases and the end of photosynthesis near the ocean surface.) **The liberated oxygen forms an ozone shield high in the evolving atmosphere—a necessity for life on land because it protects us from cosmic radiation.** Some believe that atmospheric oxygen also prevented the oceans' waters from evaporating back into space. Our realization of how bacteria created the atmosphere we depend on led to the Gaia hypothesis—the idea that Earth as a whole is alive, actively creating the conditions for new life to thrive and evolve. 3' 4"
11. **2.5 bya,** the Proterozoic Eon. **Earth learns to breath! Oxygen-loving bacteria proliferate.** 3' 4"
12. **By 2 bya, cells that have a nucleus emerge** (Eukaryotes). A miraculous and world-changing symbiosis takes place: the (bacterial) precursors of mitochondria and chloroplasts (and perhaps other organelles) take up residence inside other cells (possibly archaeons). **Plant-like protists** (which have both mitochondria and chloroplasts) **split off from animal-like protists** (which have only mitochondria). **All multicellular organisms—nearly all living things that we can see with our eyes—are descended from these first Eukaryotes.** (Though we can't see them, the vast majority of organisms and species that exist on Earth are the others, the Archaea and Bacteria.) 3' 4"
12a. 1.5 bya, **a half billion years later, Fungi split off from Animals—not from Plants!** (We are more closely related to fungi than plants are.) (Though we can guess around when this split happened, we only know about it from estimates based on "molecular clocks". The first definite fossils of fungi only appear about a billion years later in the Devonian).
13. **1.2 bya, red algae leave the first fossil record of sexual reproduction.** The sexual recombining of DNA creates untold, innumerable opportunities for new species and for evolution. **Sex is invented before death.** (Individual cells before this can die through accident or habitat loss, but they are not programmed to die, and theoretically can continue to reproduce forever, with no built-in limitation.) (Though only eukaryotes reproduce sexually, bacteria also exchange DNA, in a process called conjugation.) 5' 4"
13a. 1.1 bya-750 mya, Rodinia forms as most of the land comes together in one continent, and a quarter billion years later breaks up.
14. **800 mya, death is invented. Cells become programmed to die** ("apoptosis") **after a certain number of generations or replications.** (In our cells, the telomeres that cap each cell's chromosomes grow shorter with each replication. When the telomeres disappear the cell stops dividing.) **Death** is an engine that **accelerates change, driving the evolution of all the more complex life forms.** 2' 8"
14a. 750 mya, a "snowball Earth" (one of two major glaciations that mark the Cryogenian period). The two halves of Rodinia migrate to the North and South Poles, ending ocean circulation and leading to the total glaciation of the planet – setting the stage for the next great leap of life.
15. 635-543 mya, the Vendian/Ediacaran period. Around **600 mya, complex ecosystems of multicellular organisms emerge.** Multicellularity evolves many times independently in plants, fungi and animals; some of **these organisms begin to eat one another.** Many of the earliest organisms are large soft-bodied creatures without limbs or mouths. Nobody knows for sure whether they were multicellular or like a giant single-cell, whether they fed off sunlight or detritus or chemosynthesis. All of them disappeared (before the Cambrian period).
15b. 550 mya, **the first shells appear** (small shelly animals like *Cloudina*, then primitive molluscs)**—animals learn new ways to protect themselves. Equilibrium comes through the finest calibrations of life with death**, in ecosystems composed of hundreds of species and innumerable organisms**. The predator-prey dance that gives us the strength of the lion and the speed of the gazelle begins.** 1' 4"
15c. 600-543 mya, the parts of Rodinia come back together over the South Pole for 60 million years in the supercontinent we call Pannotia, (initiating an "ice-house" Earth.)

And there was evening and there was morning, the third day.

Netzach—**Eternity: in Kabbalah, the eye of prophecy**—reflection, sight, and insight. **Earth becomes aware.**

16. **542-488 mya, the Cambrian explosion**—ever more phenomenal innovations of life appear on Earth. Near the beginning, **sight is invented. Trilobites are one of the first groups of animals with light-sensing organs—primitive eyes. Earth begins to see herself for the first time.** Life in the form of fossils becomes a significant part of the geological record. (This begin the Phanerozoic Eon.) 5"
16a. **520 mya, the first backbones support the first central nervous systems in fish.** The brain at the apex will ultimately evolve into our brains.
16b. 490-440 mya, the Ordovician period – Pannotia splits in four. Gondwana (also called Gondwanaland), a configuration that includes half the land mass of Earth, forms, lasting for hundreds of millions of years. Jawless fish, nautiloids and molluscs (bivalves) all radiate during the Ordovician. The first cephalopods and the first jawed fish appear by the end.
17. **460 mya, fungi and green algae team up to create lichen—life that can live on rocks and turn them into Soil!** (This is sometimes called the bioerosion revolution.) **Life has been confined to the ocean and tidal zones for millions of years. Now, the first plants move onto land near the shores.** 7"
17a. **20 million years later,** (440 mya) the Ordovician period ends when **there is a mass extinction. Gondwana, one half of earth's land mass, migrates over the South Pole, leading to massive glaciation,** a severe drop in sea levels, and increased salinity, **along with tremendous loss of coastal habitat—the nursery for most species—around the world.** Then Gondwana moves away from the South Pole, and there is massive melting, a rise in sea levels, and a drop in salinity. Afterwards, the balance of oceans to land becomes similar to what we have today, and the interior of the land is finally ready to be colonized.

And there was evening and there was morning, the fourth day.

***Hod*—Majesty: life reaches upwards!** Extraordinary, diverse powers, patterns and forms of life are revealed through each unique combination of Chesed and Gevurah, flow and hardness

18. **425 mya,** (the Silurian period). **The first vascular plants** (such as Cooksonia), **able to live away from open water, emerge, leading millions of years later to giant ferns and horsetails, "woody" cells, and** conifer and cycad **trees.** (Most plants, even from the beginning, partner with fungi—mycorrhizae—to get nutrients from the soil.) By the end of the Devonian epoch (416-359 mya), **60 million years later, the Earth's land masses are covered in forests. Earth learns to reach into the sky!** 3"
18a. **400 mya, after the first arthropods** ("joint-leggeds"—spiders, then insects) **have colonized the land, insects invent flight**, perhaps from fan-like appendages meant to dissipate heat**. The first tetrapods (four-leggeds**, all still amphibians**) also come onto land.** In the oceans, sharks appear.
18b. At the end of this period (the Devonian), **there are several mass extinctions, possibly caused by the removal of CO_2 from the atmosphere by plants**, which would cooled the earth and deprived the oceans of oxygen. **The way is cleared for the next great leap**.
19. About **350 mya, the Carboniferous explosion** (from 359-299 mya)**.** The continents begin to come together to form Pangaea, creating a uniform climate across the land and in the seas that may have led to **the greatest rate of creation of new species in the history of life on the planet. This includes the Amniota—all animals that lay eggs on land (turtles, lizards and all reptiles, ancestors of dinosaurs, birds and mammals).** True spiders that could spin webs also appear. **Life again reaches upward with the appearance of** the synapsids, **tetrapods with legs <u>under</u> their bodies instead of off to the side**, and openings in the skull at their temples – (this creates a place where stronger jaw muscles can attach, allowing a few jaw bones to become inner ear bones for hearing). Synapsids and **their descendants the therapsids become the dominant form of animal life. Conifers and cycads radiate and abound. The coal swamps that sequester so much CO_2 from our atmosphere are formed.** 6"
20. 270 mya, during the Permian period, the supercontinent Pangea, containing all of earth's land, is completely formed. **251 mya, the Permian period ends in the greatest mass extinction known. 96% of all marine life and 70% of all terrestrial life disappear. This is the only extinction in the history of the planet to significantly impact insects. Of the t herapsids, only the ancestors of the mammals** (like *Lysrosaurus*, a mammal-like reptile) **do not become extinct.** Some people think that the Permian extinction was caused by an asteroid bigger than the one that wiped out the dinosaurs. Such an event would cause the world to become dark and cold from dust, and then when the dust cleared, the world would grow very hot as all the CO_2 bound up in the dead plants was released. Others attribute it to massive volcanic eruptions (over a land area greater than the state of Alaska), leading to global acid rain, the burning of vast coal beds and forests, toxic ash, destruction of the ozone layer, and vast increases in greenhouse gases. Some say both happened. 8"

And there was evening and there was morning, the fifth day.

***Yesod*—Extension in love: the evolution of relationships, feelings**, **and** the fulfillment of the promise of **love** and care.

21. By 240 mya, the world is dominated by the crocodilian archosaurs (also called crurotarsans) on land, as diverse as the dinosaurs ever became, and by pterosaurs in the sky. **235 mya, dinosaurs emerge.** (Like the synapsids,) dinosaurs walk with legs upright and can rear up on their hind legs. (Some of the early dinosaurs include sauropods like Apatosaurus, aka Brontosaurus. Later ones include the carnivorous therapods like T. Rex—which never lived at the same time as Apatosaurus.) At the end of the Triassic epoch (205 mya), almost all the crocodilians become extinct, probably due to climate change caused by volcanic eruptions, and the dinosaurs become dominant. **Some of these dinosaurs become warm-blooded, which means they have to incubate their eggs—creating some of the first obligate parent-child relationships.** (Like crocodiles today, some of the crocodilians may also have had mother-child relationships, because of the need to guard their eggs and young from being eaten by their own species!) 2"
22. **215 mya, the first mammals emerge** (having hair, lactation, a neocortex, ear bones, and specialized teeth, like *Megazostrodon*)**. A few small species live in the shadow of the dinosaurs for 150 million years.** Frogs, which began to evolve in the Permian, also radiate during this time, perhaps becoming the first species that sings! 1.5"
22a. 205 mya, the Triassic epoch ends with the extinction of most archosaurs; the Jurassic begins. Many Jurassic dinosaurs have hipbones that let them walk on two legs, like birds. Pangaea begins to break up about 30 millions years later. In the oceans, brown algae emerges.
23. **150 mya, the first birds—really dinosaurs with feathers** (like Archaeopteryx)**—emerge.** The Jurassic ends when Gondwana breaks up (and separates from Pangaea), 150-140 mya. 5"
24. **120 mya, flowers emerge—**angiosperms—and plants begin to share pollen, nectar and fruit . The intricate dance between insects and plants which sustains so much life today begins. **Earth is clothed in new colors.** 2.5"
25. **105 mya, only 20 million years after** their first ancestor (eutherian), called **Eomaia, the "Dawn Mother", all the major families of placental mammals—animals that nurture their young in utero, warm-blooded and with the potential for great intelligence—have emerged. The mammals develop deeper and deeper relationships based on nurture and love.** In the oceans, octopuses, the most intelligent of the invertebrates, first appear in the fossil record (95 mya). 1.5"
25a. 93 mya, undersea volcanic eruptions spur a global anoxic event in the ocean, leading to a massive die-off of marine life, storing away carbon to become one important source of the oil we find today.
26. **65 mya, the end of the Cretaceous period** and the Mesozoic Era**. An asteroid strikes the earth, causing the extinction of the dinosaurs** (with the exception of the ancestors of birds)**, leaving the stage open for mammals and birds to radiate into so many diverse species and sizes.** (Flowering plants also radiate.) **The** Cenozoic **Era of birds and mammals begins.** 3"
27. 55 mya, **10 million years later, the mammals that survived the great extinction become the dominant form of animal life** , diversifying and occupying all the niches once held by the dinosaurs, **while the birds have radiated into their own extraordinary varieties**, replacing the pterosaurs. New species come quickly. Deciduous trees also become dominant in many landscapes. 1"
27a. 55 mya (the Eocene period), the first whales appear; geese, ducks, herons, owls, hawks; modern crabs; even-toed mammals (called artiodactyls) appear everywhere; rodents emerge. (All modern odd-toed families of mammals—perissodactyls—are now present.) Mammals (in the form of bats) learn to fly.
27b. **34 mya** (the Oligocene), camels, sloths, ants, termites, monkeys, great apes, elephants, pigs, cats and dogs appear. **Multituberculate mammals**, named after their unique teeth**—the longest-lived branch of mammals thus far—become extinct after 100 million years, as the rodents displace them.**
27c. 23 mya (the Miocene), giant deer, giraffe, raccoons and weasels appear; giant beavers (7' long); whales proliferate; saber-tooth cats are the dominant hunter. All the modern families of mammals are now present. Kelp forests grow in the oceans.
27d. **20 mya, the climate becomes cooler and drier; grasslands replace forests.** Because grasses grow from the base of the stem rather than the tip, they can be grazed and still thrive. They co-evolve with the ruminants (all the kosher animals) which, along with horses, become dominant in these landscapes. **Grazing becomes a way of life.**

28. **6 Mya, African apes stand up, walk on two legs, and leave their forest home** (adapting to newly emergent savannas). (Ardipithecus is followed by Australopithecus at 4 mya, Homo habilis at 2.3 mya.) (Our ancestors may have been driven to become masters of adaptation because of rapid and repeated climate change in the African Rift valley.) 4"
28a. 5.3-2.6 mya (the Pliocene period), new mountains created by the collisions of India with Asia, Italy and Spain with Europe, create mountain ranges trapping ice, lowering sea levels, and contributing to the developing Ice Ages. (The Panama isthmus is formed 3 mya, allowing the mixing of North and South American species for the first time.)
28b. 2.6 mya, the Pleistocene period. Ice Ages drive human migrations, and flora and fauna changes. By the end of the Pleistocene (12,000 ya), humans have arrived on every continent. ***Adam*, humanity, will come to fill and occupy every continent and land habitat of *Adamah*, the Earth.**

And there was evening and there was morning, the sixth day.

***Malkhut—Shekhinah*: the full manifestation of divinity in the physical world**; the planet, all creatures and ecosystems, and the whole Universe, become unified and aware through the cultures and consciousness of humanity. Earth sees herself!

29. **150 to 200 thousand years ago, modern humans** (Homo sapiens) **& human language emerge.** 1"

The remaining events are symbolized by the last candle. *There may be a bit of rope left over.*

A. **30,000 ya, the first cave paintings are drawn in Europe.**
B. **Between 20,000 and 16,000 years ago, humans cross into North America. During this time period, the megafauna of the American continent disappear, hunted to extinction by humans.** Consciousness of this change may have been the bedrock for the religions of the Native Americans that view all species as relations and that consciously protect the land. The disappearance of the megafauna, along with similar extinctions in Europe, Australia, and other places, may mark the beginning of the next great extinction.
C. **13,000 ya, human farming and herding emerge.** From here the acceleration of human cultural change grows by orders of magnitude.
D. **8,300 ya, Sumer (in the Fertile Crescent) develops intensive irrigation for grain-based agriculture, leading to great population increases, city settlements and slave castes of farmers and soldiers. This society destroys itself when the land becomes salted over many generations by the groundwater used for irrigation.**
E. **5,000 to 4,000 years ago, classical civilizations, law & religions emerge: Hinduism, Mesopotamia and the beginnings of Judaism with Abraham's journey**, Egypt, and Babylon (Hammurabi's code, 3700). Some people think Abraham's journey and the origins of Israelite consciousness stem from an awareness of how Sumer destroyed itself by acting as if it owned and had power over the fertility of the earth.
F. **3200 years ago, the Exodus from Egypt, according to Jewish tradition. A people endeavors to create a new relationship to the land that is the exact opposite of Egyptian ecclesiastical hierarchy and Sumerian slave society.**
G. 2600 years ago, the Buddha founds a new religion in India based on consciousness. In Persia, Zoroastrianism begins.
H. **2200 years ago, humanity first wonders if the earth rotates and travels around the sun.** (Aristarchus) Over the next 800 years people will recognize that the Earth travels around the Sun (Aryabhata, al-Biruni, Copernicus, Galileo, Kepler), that the Sun is one of many stars (Bruno), and that the force which moves the Earth around the Sun is the same force that makes things to fall to the Earth. (Newton)
I. **2000 years ago, the Temple in Jerusalem is destroyed. Rabbinic Judaism and Christianity begin.**
J. 1400 years ago (610), Islam begins (Mohammed).
K. 500 years ago (1520), Protestantism begins (Luther).
L. **172 years ago** (1838)**, humanity** (calculates the distance to some of the stars and) **learns** for certain **that the sun is a star.** (Bessel) (The idea that the sun is a star was first suggested in 450 BCE by Anaxagoras, and Bruno was burned at the stake in 1600 partly for proclaiming this idea.)
M. **141 years ago** (1859)**, human beings learn that all life descends from a common ancestor.** (Darwin)
N. 107 years ago (1903), human beings are the most recent animal to learn to fly (in the first powered flight)—and will go higher than any other. (Wright brothers)
O. **105 years ago** (1905) and 94 years ago (1916), humanity discovers that time and space are unified, that both contract as one approaches the speed of light which is absolute, that matter can be converted to energy ($E=mc^2$), and that gravity curves space and can bend light. (Einstein)
P. Starting 97 years ago (1913) **and continuing over** two **decades, humanity leaps from discerning the fabric of space-time to unraveling the structure of the atom, understanding** that energy is quantized, that all phenomena are particle and wave, that antimatter exists and virtual particles fill all space, that on the subatomic level we can only know probabilities. Humanity discovers **how the sun creates energy, and how to make** (hydrogen) **bombs that mimic that process.** (Bohr, Heisenberg, Dirac, Fermi, et al)
Q. **Around 85 years ago, humanity discovers that there are other galaxies besides our Milky Way** (1925), **and observes the expansion of the Universe** (1929) in the redshift of galaxies (the further away a galaxy is the more its light is redshifted— confirming that space itself has been expanding ever faster since the beginning of time). (Hubble and Humason)
R. A decade and more later (1939, 1946), humanity discovers that chain reactions form all of the heavier elements through iron inside stars. (Bethe, Hoyle) Soon after (1951), the resonance energy of the carbon-12 nucleus is predicted based solely on the anthropic principle (that nucleosynthesis inside stars must be exactly fine-tuned to create carbon in order for life to exist). (Hoyle)
S. **55 years ago** (1953)**, humans discover DNA, life's common language.** (Watson, Crick and Franklin)
T. 48 years ago (1962), humans begin to wake up to the effects of pesticides and pollution (with the publication of Silent Spring). (Carson)
U. **45 years ago** (1965)**, humans observe the origins of the Universe in the cosmic microwave background.** (Penzias and Wilson)
V. **38 years ago** (1972), **humanity sees the Earth as a whole from space.** (Apollo 17) (An earlier picture called "Earthrise", from Apollo 8 in 1968, shows a half-earth rising above the lunar horizon.) **Earth sees herself for the first time!**

And God saw everything that God had made, and here: it is very good!

Today, humanity is realizing that our activities are not only changing individual ecosystems and habitats, but also the entire global climate system. We face the prospect of massive, chaotic climate change and the disruption of ancient sytems of life. We wonder: **Has the next great extinction since the end of the dinosaurs already begun?**

The Story of the Universe is our sacred Story. The next step is in our hands. As we tell this story, we can pray that humanity will change course and resolve to act to protect this beautiful planet. At the same time, we have learned from the past that, regardless of what happens, life will continue on Earth, taking new forms, and reaching new heights. **Together, we share the hope that the descendants of humanity, our descendants, will continue to be part of this sacred journey through the Universe.**

Version II. Just the boldface phrases from Version I—a simpler telling
Rabbi David Seidenberg, neohasid.org. Measurements can be found in Version I.

The Cosmic Walk is a telling of the story of the Universe according to current science, as a sacred story that fits into our spiritual and religious traditions. It was created by Sister Miriam MacGillis. This version comes from neohasid.org. It structures the telling according to the "seven days of creation" which, according to Kabbalah, are actually the seven lower qualities through which God created the world. The spiral rope you see represents 13.7 billion years; ten feet equals about one and a half billion years.

When the story of the Universe is told in science museums and textbooks, time is often represented by a straight, very long line, with the whole of human history being only the tiniest sliver at the very end, visually separated from the rest of the story by whatever happened just before us. In contrast, as we walk the spiral, the beginning is visible from every point; we stand in relation to the whole story at all times. Similarly, we are taught that our solar system is one of billions and trillions of specks in comparison with the whole of the Universe. But if there is only a one in one billion trillion chance of life beginning on a planet like ours, then a billion trillion such planets might be created in order for life to evolve!

All of these miracles, exactly as they happened, were needed in order for us to be here. You are invited to be a witness, and to experience gratitude, awe, or any other emotions that arise. At the end of the telling, you can walk the spiral. After a few minutes of meditation, all kinds of celebration are welcome!

In the beginning…

***Chesed*—Love: expansion through love, free energy created out of nothing, the revelation of light.**

1. The Great Emergence, 13.7 billion Earth years ago. Yesh Me'ayin, something from nothing, creatio ex nihilo—no words we have can describe what happened. A constriction to a point, or contraction away from a point—in Kabbalah, *tzimtzum*, creating a womb-space for the first light, the *Or Haganuz*, hidden light, or *Or Ein Sof*, endless light, drawing the Universe into extraordinary inflation and expansion, propelled by dark energy. Quarks emerge from the ether pulsing, exploding, with energy. 3 minutes after the Big Bang quarks have formed into protons and neutrons. 13 minutes after the Big Bang, the Universe *neohasid.org/ecohasid/cosmicwalk***is filled with 75% hydrogen nuclei and 25% helium nuclei. A beginning filled with all promise of whatever was and whatever will be.**

2. 380,000 years later, the Cosmic Web emerges. A burst of radiation is released as the seething plasma—protons, neutrons and electrons—cools enough to combine to form atoms. This burst of light, traveling through billions of light years, is the cosmic microwave background radiation that we can still see today. Minute differences in the distribution of matter allow gravity to start pulling the primal elements and particles together, leading hundreds of millions of years later to the first stars. Afterwards, the Universe, though filled with light, becomes opaque.

3. 200-400 million years later primal stars emerge. Created in a world almost devoid of what astronomers call "metals"—elements heavier than helium—these stars may have been many hundreds of times larger than the sun. Over millions of years, these stars and their descendants reionize the interstellar hydrogen, making it transparent again.

4. 300 million years later, galaxies emerge, made up of vast systems of stars.

5. Two and a half billion years later, some people believe that dust in interstellar space, made up of elements created inside older stars, could have produced the first "organic" molecules.

And there was evening and there was morning, one day.

***Gevurah*—Might: creation through limiting, shattering, destruction. Our planet is born.**

6. **4.6 billion years ago (5.9 billion years later), the birth of our solar system. Millions or billions of years before, our grandparent stars died as supernovas, sending forth new matter which now forms planets and asteroids; a surrounding cloud of hydrogen collapses to ignite as our Sun. Every atom on earth and in your body is older than the Sun; every one besides hydrogen was created inside a star. Earth is born.**

7. **4.3 bya, the Hadeon Era. The gravity of the outer planets sweeps debris left over from the creation of the solar system into a collision path with Earth. One of the greatest collisions creates the moon. The Earth-Moon dance, and the tilt of the Earth, are created. At the end of this time, comets of ice also strike the earth, bringing the water that will create our planet's oceans.**

And there was evening and there was morning, the second day.

***Tiferet*—Balance and Beauty: the intertwining of expansion and restriction, which leads to dynamic growth, death and birth. Earth comes to LIFE!**

8. **3.9 bya, the Archaeon Era, life emerges, in mystery, through perhaps unfathomable processes. The first cells, ancestors of archaea or bacteria replicate in the oceans.**

9. **3.5 bya, Bacteria split off from Archaea.**

10. **3 bya, cyanobacteria invent photosynthesis. Earth learns to feed on sunlight! Millions of years of photosynthesis create a new atmosphere filled with oxygen – poisonous to most of the life that existed then. The liberated oxygen forms an ozone shield high in the evolving atmosphere—a necessity for life on land because it protects us from cosmic radiation.**

11. **2.5 bya, Earth learns to breath! Oxygen-loving bacteria proliferate.**

12. **By 2 bya, cells that have a nucleus emerge. Plant-like protists split off from animal-like protists. All multicellular organisms—nearly all living things that we can see with our eyes—are descended from these first Eukaryotes. A half billion years later, Fungi split off from Animals—not from Plants!**

13. **1.2 bya, red algae leave the first fossil record of sexual reproduction. Sex is invented before death.**

14. **800 mya, death is invented. Cells become programmed to die after a certain number of generations or replications. Death accelerates change, driving the evolution of all the more complex life forms.**

15. **600 mya, complex ecosystems of multicellular organisms emerge. These organisms begin to eat one another. The first shells appear—animals learn new ways to protect themselves. Equilibrium comes through the finest calibrations of life with death. The predator-prey dance that gives us the strength of the lion and the speed of the gazelle begins.**

And there was evening and there was morning, the third day.

***Netzach*—Eternity: in Kabbalah, the eye of prophecy. Earth becomes aware.**

16. **542-488 mya, the Cambrian explosion. Sight is invented. Trilobites are one of the first groups of animals with light-sensing organs—primitive eyes. Earth begins to see herself for the first time. 520 mya, the first backbones support the first central nervous systems in fish.**

17. **460 mya, fungi and green algae team up to create lichen—life that can live on rocks and turn them into Soil! Life has been confined to the ocean and tidal zones for millions of years. Now, the first plants move onto land near the shores. 20 million years later, there is a mass extinction. Gondwana, one half of earth's land mass, migrates over the South Pole, leading to massive glaciation, along with tremendous loss of coastal habitat—the nursery for most species—around the world.**

And there was evening and there was morning, the fourth day.

***Hod*—Majesty: life reaches upwards!**

18. **425 mya, the first vascular plants able to live away from open water emerge, leading millions of years later eventually to giant ferns and horsetails, "woody" cells, and trees. 60 million years later, the Earth's land masses are covered in forests. Earth learns to reach into the sky! 400 mya, after the first arthropods have colonized the land, insects invent flight.The first tetrapods (four-leggeds) also come onto land. There are several mass extinctions, possibly caused by the removal of CO_2 from the atmosphere by plants. The way is cleared for the next great leap.**

19. **350 mya, the Carboniferous explosion. The greatest rate of creation of new species in the history of life on the planet. This includes the Amniota—all animals that lay eggs on land (turtles, lizards and all reptiles, ancestors of dinosaurs, birds and mammals). Life again reaches upward with the appearance of tetrapods with legs under their bodies instead of off to the side. Their descendants the therapsids become the dominant form of animal life. Conifers and cycads radiate and abound. The coal swamps that sequester so much CO_2 from our atmosphere are formed.**

20. **251 mya, the Permian period ends in the greatest mass extinction known. 96% of all marine life and 70% of all terrestrial life disappear. This is the only extinction in the history of the planet to significantly impact insects. Of the therapsids, only the ancestors of the mammals do not become extinct.**

And there was evening and there was morning, the fifth day.

***Yesod*—Extension in love: the evolution of relationships, feeling, love.**

21. **235 mya, dinosaurs emerge. Some of these dinosaurs become warm-blooded, which means they have to incubate their eggs—creating some of the first necessary parent-child relationships.**

22. **215 mya, the first mammals emerge. A few small species live in the shadow of the dinosaurs for 150 million years.**

23. **150 mya, the first birds—really dinosaurs with feathers—emerge.**

24. **120 mya, flowers emerge. Earth is clothed in new colors.**

25. **105 mya, only 20 million years after *Eomaia*, the "Dawn Mother", all the major families of placental mammals—animals that nurture their young in utero, warm-blooded and with the potential for great intelligence—have emerged. The mammals develop deeper and deeper relationships based on nurture and love.**

26. **65 mya, the end of the Cretaceous period. An asteroid strikes the earth, causing the extinction of the dinosaurs, leaving the stage open for mammals and birds to radiate into so many diverse species and sizes. The Era of birds and mammals begins.**

27. **10 million years later, the mammals that survived the great extinction become the dominant form of animal life while the birds have radiated into their own extraordinary varieties. 34 mya, Multituberculate mammals—the longest-lived branch of mammals thus far—become extinct after 100 million years, as the rodents displace them. 20 mya, the climate becomes cooler and drier; grasslands replace forests. Grazing becomes a way of life.**

28. **6 Mya, African apes stand up, walk on two legs, and leave their forest home. *Adam*, humanity, will come to fill and occupy every continent and land habitat of *Adamah*, the Earth.**

And there was evening and there was morning, the sixth day.

***Malkhut—Shekhinah*: the full manifestation of divinity in the physical world**

29. **150 to 200 thousand years ago, modern humans & human language emerge.**

The remaining events are symbolized by the last candle.

A. **30,000 ya, the first cave paintings are drawn in Europe.**

B. **Between 20,000 and 16,000 years ago, humans cross into North America. During this time period, the megafauna of the American continent disappear, hunted to extinction by humans.**

C. **13,000 ya, human farming and herding emerge.**

D. **8,300 ya, Sumer (in the Fertile Crescent) develops intensive irrigation for grain-based agriculture, leading to great population increases, city settlements and slave castes of farmers and soldiers. This society destroys itself when the land becomes salted over many generations by the groundwater used for irrigation.**

E. **5,000 to 4,000 years ago, classical civilizations, law, & religions emerge: Hinduism, Mesopotamia and the beginnings of Judaism with Abraham's journey.**

F. **3200 years ago, the Exodus from Egypt according to Jewish tradition. A people endeavors to create a new relationship to the land that is the exact opposite of Egyptian ecclesiastical hierarchy and Sumerian slave society.**

G. **2200 years ago, humanity first wonders if the earth rotates and travels around the sun.**

H. **2000 years ago, the Temple in Jerusalem is destroyed. Rabbinic Judaism and Christianity begin.**

I. **172 years ago, humanity learns that the Sun is a star.**

J. **141 years ago, human beings learn that all life descends from a common ancestor.**

K. **105 years ago, and continuing over decades, humanity leaps from discerning the fabric of space-time to unraveling the structure of the atom, understanding how the sun creates energy, and how to make bombs that mimic that process.**

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