

From Wisdom to Innocence: Passing on the Knowledge of the Night Sky

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Memorable learning can happen when the whole family shares the thrill of discovery together. The fascination of the night sky presents a perfect opportunity for gifted parents and children to experience the tradition of passing on knowledge from generation to generation.

Bright colors in the scrod signify the world and the stars that surround it. The seeker of wisdom draws delicate lines, then scoops the scrod and pours it back over itself, colors blending, returning them to the earth from which they came.

Bright colors on the graphics display monitor signify the planet and the stars that surround it. The seeker of wisdom drags digitized pixels across the straw, enhancing the image for the Internet, then closes the file, colors blending, returning them to the database from which they came--earthbound messages that traveled through space from an instrument sent there from here.

Our lives spring out of the earth. Our eyes lift up to the stars beyond. Our minds expand beyond the brimming boundaries to discover mot-c, which we draw deeply within ourselves to construct an ever truer picture. We express our experience somehow, in a song, a gesture, a whisper of low, an action of living, a scientific theory-- until we, like the colors of the sand, are poured back into the earth from which we come, and younger minds, new sinkers of wisdom come into their own.

By night I squint my eyes to penetrate the mysteries of distant stars and planets. By day I look into the equally inscrutable gifted and talented faces of nearby children. I stretch out my arms, reaching for a connection between the two. I lean my hands across the keyboard of a NASA computer at the Jet Propulsion Laboratory, writing experimental curriculum, as I capture in silicate memory some innovative ways for teachers to bring space science to schoolchildren of all ages. Then I race across town to the *real laboratory--the classroom--* to put the ideas into action, from the outer planets to the inner city, where it counts. When I step into the room, I ask students to stand up out of their seats, reach their hands up and deep into their minds to stretch their imagination. Depending on the day, we may be measuring out the relative distances of the planets, or working in teams to plan an interplanetary exploration mission.

When I teach about space science as enrichment for a gifted program, I hope to inspire, a healthy self-awareness, a culturally-rich global awareness, and a science-]itrate *cosmic* awareness, interpersonal, intercultural, intergalactic in scope. A tall order? Yes, but it's what we *must* provide when we have alert third-graders asking, *what's beyond the universe?* When we have talented fourth-graders creating dramatic versions of the formation of the solar system. When we have divergent thinking fifth-graders designing, imaginative details for new spacecraft. When we have bright middle school and high school students looking askance with skeptical eyes, jarred by the world's downside, vaguely hoping for a future worth striving for.

EDUCATING OUR COSMIC AWARENESS

Gifted young people often think that what we teach them in science is somehow *set*. Nothing is new under the Sun. Missing from the equation is the thrill of real discovery, and the awareness that *real discoveries are taking place everyday!*

On the opening page of Gabriel Márquez Garcia's novel *One Hundred Years of Solitude*, a Gypsy named Melquíades comes through town hawking the marvels of magnetism. "Things have a life of their own!" he declares. With that tantalizing point of view, we can approach *things* in a new way.

Here we are: ours is the first generation in the *history of humanity* that has seen Earth from space. From space no political boundaries are drawn. Earth is something whole, part of a larger whole, a solar system, a galaxy, a universe. Space exploration is no longer a rivalry between competing ideologies, but an internationally cooperative endeavor that contributes to global awareness, intercultural appreciation, and world-wide science literacy. The wonder and awe of the sheer scale of the night sky merges with scientific theory as we refine our understanding of what these *things* in the cosmos really are.

Kosmos (Κοσμος), in the original Greek, means the beauty and order of the universe. Cosmology is the study of how we form our world view, our concept of how it all fits together. How do we help our young people attain their own sense of cosmic awareness?

The first step is to recapture that sense of wonder that the sky offers to every one of us. Throughout human history, people everywhere have projected onto the heavens their most impassioned stories. Skywatching is one of the oldest pastimes of all humankind. For thousands of years people have observed and kept track of movements of the Sun, the nearby planets, the distant stars creating complex systems of observation and applications of astronomical data *using only the technology of the naked eye*. Even today, looking with our own eyes is the best place to start!

Astronomical knowledge is based on *inference* from the evidence of the light that we see. What we see of the stars and other celestial bodies reaches us through space, filtered through the Earth's atmosphere, the light enters into our eyes where it triggers responses in our retina and alerts our mind to notice. Even with advanced technology, all we really know about the stars and planets is the result of careful thought about the meaning of the light that we see. Looking at the evidence is a mix of creative inference and scientific intuition.

The main disadvantage about teaching space science in a school setting is that the night sky is not available to us as a direct teaching tool during the day. Observing must be assigned as homework. This provides a perfect chance to engage the whole family, from wisdom to innocence.

As a *family* project, skywatching becomes an opportunity for the generations to learn together. By retracing the pathway of the ancient skywatchers, we discover our own innate abilities to observe, perceive and reason about the events of the sky--and most importantly, *how to shine these experiences*. When we recover this important knowledge by direct experience, the technical and mathematical concepts become easier to grasp later on. I am going to share with you some practical ways to make this happen.

CREATE YOUR OWN PERSONAL OBSERVATORY

Your PERSONAL OBSERVATORY is ANYWHERE you are when you OBSERVE an event in the sky. To include every direction, you may need several vantage points, or you may be lucky enough to find that one spot offers you a wide expanse of sky. You are your own instrument. Your eyes are natural binoculars. Your mind is attuned to patterns. Your arms can help you measure angles. You can stand on your front porch, or in your backyard. You can stand on the balcony of your apartment, or you can look out your window. Wherever a patch of sky is visible-- you can OBSERVE!

The most important thing is to return *again and again* to your PERSONAL OBSERVATORY to collect OBSERVATIONS to watch for PATTERNS, and to attempt to UNDERSTAND what the patterns imply. Once you have spent time looking for yourself-- the literature of space science, astronomy, and archaeoastronomy will open up to you-- because you will know what they are talking about, from EXPERIENCE.

Here's a scene I'd like to see played out by gifted families across the nation:

It's after dark. Early evening. You, the wise parent, make some popcorn or hot chocolate, or whatever may be the right touch. When you're ready, turn off the TV, or any other distracting electronic device. Announce to your children that there's a special show you want them to see, outside. Over all objections, stand firm. If there's a chill in the air, have everyone throw on a jacket. Step outside. Turn off the porch light. Find a comfortable spot free of the direct glare of nearby lights. Have everyone take in a deep breath and look up, letting out the air in an audible *Ta-Da!* The stars! Just look! In the City? Can't see hundreds, but only a few dozen? *Don't let that stop you!* Can't name a constellation? *Don't worry!* See what patterns you see with your own eyes! Just look! Look for a while. See what you see! Let your eyes wander across the expanse of night sky. Keep looking and you start seeing *more*. Things you didn't

quite notice at first, like the different colors of stars. After about ten or fifteen minutes, your eyes seem suddenly to grow in their ability to SEE.

FINDING YOUR WAY AROUND THE SKY: THE HORIZON REFERENCE SYSTEM

The Horizon is that part of your visual field where the sky seems to meet the edge of the world. The True Horizon is where the sky seems to meet the ground without anything in the way--trees, hills, mountains, buildings--for example, looking out from the shore of an ocean. Point straight ahead and then turn about to describe a circle to represent the True Horizon looking from your personal observatory, in all directions, 360° around.

Azimuth: Notice what you see on the Horizon from your Personal observatory. Maybe there's a tree straight ahead, or a telephone pole off to the side, or the roof of the building, across the way. Stand up, looking into the direction that gives you your own *favorite view of the night sky*; point both arms outstretched straight ahead, call this 0° ; keeping your left arm straight ahead, point your right arm directly to your right, forming a right angle, 90° ; still keeping your left arm straight ahead, point your right arm directly back behind you, forming an angle of 180° ; now return both arms pointing straight ahead; this time keep your right arm pointing straight ahead and point your left arm directly to your left, forming a *left* angle (well, actually, forming a right angle to the left), 270° ; then sweeping both arms straight ahead to 360° which is the same as our 0° starting point. You have now marked off four cardinal directions of your own horizon reference system. Notice the landmarks, especially at the locations of your four main directions. These buildings, trees, and other landmarks, are your Horizon References. This measurement from 0° through 360° of the circle along the horizon is called the *azimuth*. You can *calibrate* your Horizon Reference System by aligning your horizon references to the four traditional cardinal directions: North, 0° ; East, 90° ; South 180° ; and West, 270° .

Altitude: Now point straight up. "This is the Zenith. We can measure how far up an object is from the horizon. Notice that if you point with one arm to the true horizon in any direction and point straight up to the zenith point, that this forms a right angle, or 90° . This measurement from 0° at the horizon to 90° at the zenith is called the *altitude*. We can measure the angular altitude of any object in the night sky.

With these two measurement concepts, azimuth, the position in relation to the horizon, and altitude, the position up from the horizon to the zenith, you can refer to any position in the sky.

COLLECT A SERIES OF OBSERVATIONS

You now embody a scientific instrument that can help you keep track of ^gwhat you see and where you see it @ *any particular time and place*. Point to a star that interests you. By looking to see the horizon reference directly below, you have the azimuth reading. By estimating the angle formed from the horizon going up, you have the altitude. In your field notebook, you can jot down the AZIMUTH and ALTITUDE readings along with the DATE, TIME & PLACE of each observation, a drawing and description of what you see. (Later on, you can convert your Horizon Reference System data to other reference systems that astronomers use.)

If you see a star straight ahead and up about halfway, now you can say, look, there, at 0° azimuth and 45° altitude. Or there's Venus at about 290° azimuth and about 30° altitude. You can watch the same object from night to night at same time and notice the gradual shift in position as Earth wends its way around the Sun. Or notice how stars shift position throughout the night, as Earth rotates.

EXPRESS PATTERNS OF STARS YOU SEE

Draw an arrangement of stars that attracts your attention. You don't have to KNOW about classical star constellations at the outset to look and learn from groupings of stars. The first step is just to LOOK and let the looking have an effect on you. Pick any group of stars that interests you, a well-known constellation, or simply a group of stars whose arrangement reminds you of a particular shape, image or idea-- or perhaps a mythical figure. Look for patterns, groups of stars that seem to form shapes as our imaginations try to make them into pictures, as you might watch cloud forms pass overhead on a summer day. Connect the dots into figures that have meaning for you or otherwise illustrate so others can share in your imaginative discovery. Tell each other what you see, and what it makes you imagine. Make up and then act out a mythical story about a constellation you discovered.

In our scientific age, we too often consider mythic images as vestigial relics, valued solely for their literary or historical interest. Yet the very names we accept today for stars, planets, and constellations are based on Greek, Roman, Arabic, and European science and mythology. The very exercise of constructing our own cosmic vision in the sky engages us in the very process that ancients and moderns alike share in common: to learn about space is to learn about ourselves as well.

If you've taken your own time to enrich your own life and the lives of your children, by creating your own personal observatory, and collecting observations of your own, you'll be participating in the great events of space exploration--from *Voyager* to Pluto, from the Shoemaker-Levy Comet striking Jupiter to the appearance of Comet 1 Iyadutake, from astronauts living and working in orbit to humans landing on Mars--sharing the wisdom, and passing it on. When the whole galaxy is their neighborhood, you walk with a mind-on, cosmic awareness that can keep them sensible when things get tough on their own street.

What we begin in the gifted classroom as a science class that brings in the fundamentals of physics, astronomy, mathematics, and relates mythology, art, and the roots of cosmology--must be extended as a truly *familiar* experience on the home front. It is enough just to be together for awhile, just looking from your personal observatory, *from wisdom to innocence, all the way to the stars,.. and back!*

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Richard Shope studied intercultural communications at the University of Minnesota. He studied with mime master Marcel Marceau. He has performed mime shows based on mythical themes throughout the United States, Europe, and Mexico. He devised a kinesthetic approach that uses mime to teach content across the curricula. He founded an educational consultant company, Mime Media, to offer performances, classroom teaching and teacher in-services in school districts throughout Southern California and Mexico, particularly for gifted and talented education. He became fluent in Spanish while studying bilingual education at the University of the Americas in Mexico City. He completed his B.A. in Liberal Studies emphasizing English and anthropology at Antioch University, Los Angeles. He is currently pursuing a combined Masters and Doctorate program in Science Education at the University of Southern California. He is past chair of the Global Awareness Division of the National Association for Gifted Children (NAGC). He is an active speaker at education conferences nationwide, particularly the National Science Teachers Association (NSTA). He is currently writing science curriculum for ^{the} (NASA's) Jet Propulsion Laboratory as the Curriculum Development Lead for the Pluto Educational Outreach Program. He is married and has two children.