"DOG KITTIES"

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"I am set to light the ground
While the beetle goes his round.
Follow now the beetle's hum;
Little wanderer, hie thee home."

-- William Blake, "A Dream"
from *Songs of Innocence*

Ellen took 9-month-old Ali over to see the group of newborn puppies. "Kitties," said Ali in her newly comprehensible but still infantile voice. "Kitties." Ali's first word was "kitty", having been spoken or at least understood by us for the first time two months earlier when she attempted to crawl toward a small feline sunning itself on the sidewalk. "No," insisted Ellen, "Puppies. Dog. Baby dogs. Puppies." This dialogue repeated itself several times. Ali sat pensively. Then, at last, with an exasperated look, she quietly but firmly announced, "Dog Kitties!"

I am persuaded on the basis of experience that young children from the very earliest age are far more adept at reasoning than most adults and many educators are willing to give them credit. They lack experience, true, and the names of things, but young children spend most of their waking hours working to make sense of their world, contemplating similarities and differences, and categorizing their experiences through endless binary oppositions: moveable/immoveable; responsive: living/unresponsive: non-living; touchable: not hot/untouchable: too hot!; larger/smaller (than themselves); accessible, via crawling or climbing/inaccessible, out of reach; mothering: feeding possibilities/unmothering: no food!; squishy/hard; light/dark; salty/sweet; wet/dry; dangerous/comforting. The list multiples especially rapidly, as it is not tied to the narrow confines of language, and feeds on the acuity of all five senses (and maybe more), newly unwrapped and sparkling, neurons crackling with information in expanding convolutions of the developing brain. The associative rivers divide and redivide into eddies of knowledge, many of which turn into puddles and eventually dry up unless fed by new streamlets of information and experience. I am convinced that for many children past their earliest years, age brings with it a forgetting, as their stream of experience is so limited by societal, school, and home requirements for "efficiency" in childrearing, as in virtually everything else.

Ali's verbal precocity was well rewarded and reinforced by us with attentive listening and responsiveness, but it should not be assumed that young children who take more time to speak in words comprehensible to adults are in any sense intellectually slower. Most of the work going on for the young child is interior work. In some cases, the fact that individual children learn to speak "late" (if there is such a thing) may simply reflect the richness of their interior life and the difficulty of fitting that richness to words. Additionally, much of the effort involved in speaking reflects the development of auditory skills and manipulation of facial muscles. And perhaps most critically,

young children must figure out a way to ensure adults will listen to them!

When we moved to the West Coast from Philadelphia, I decided it was time for me to learn something about trees, or at least be able to identify them by name. Whether it is my New York upbringing or some other factor I am not certain, but I have never felt wholly comfortable in a natural environment unmediated by human effort. I have tried to mitigate this discomfort -- with only partial success -- by the process of naming. This is *not* the way to do it, Ali first taught me by her example. Now she is able to be more explicit. "The name of a living thing doesn't tell you anything about what it really *is*", noted Ali as she read the beginning of this paragraph, and she's right of course. Plant or animal names are superficial, human-devised labels and tell us nothing about what they really are and their interrelationships in the web of life, the stuff of which genuine nature education is made. Still, armed with tree identification guide, I would push Ali down the street in her stroller, explaining, as if she fully understood, the names and characteristics of various species we encountered. I took especial delight in sharing the name of the tall monkey puzzle tree (*Araucaria araucana*) in the neighborhood, brought to Santa Cruz from Chile almost a hundred years earlier. Of course, for a long time, maybe to this day, I was better at identifying trees on the printed page than when faced with the real deal. Looking back at it, I would have been better off taking a tree identification walk with a resident naturalist. It is a scary thought to consider that this is what the kids thought I was!

Nonetheless, walking down one particular street with 18-month-old Ali in front of me, I came upon a young tree with leaves similar to a type of maple or sycamore but with very different bark. I mused on this aloud, and scrambled through the guide to determine it was a sweet gum tree (*Liquidamba styraciflua*). Ali looked up at me from the stroller and uttered one word in her tiny, squeaky voice: "Library." "What's that, Ali?" "Library." "Library?" "Library." The next day I walked with her downtown to the library. There, lined up by the entrance, were no fewer than eight sweet gum trees.

When she was 2 or thereabouts, Ali befriended a Deodar tree (*Cedrus deodara*) on the corner. She would hold imaginary tea parties under it, sharing tea and conversation with her confidant. (I, unfortunately, will never know whether the conversation was two-way.) For several years, Ali held birthday parties for Cedar. We would be invited down to visit and sing "Happy Birthday" while Ali tied a ribbon around a low-hanging branch. Cedar lived 30 feet from Fred, an extremely rare prehistoric species, I learned, not to be found in any popular tree identification book, and which regularly dropped its leaves at the height of spring. To this day, Ali occasionally engages in conversation with plants.

The trees in our Olympia neighborhood, where we moved after leaving Santa Cruz, seemed to foster questions. Ali once asked me why all the trees in the area have green leaves except for the thundercloud plum (*Prunus cerasifera* 'Nigra'). She seemed to enjoy accompanying me to the garden stores around town to ask her question, and was amused by the inability of adults to provide an explanation. Finding an answer became a family project. A dozen library books and half a dozen phone calls later, a Washington State University agricultural extension agent was finally able to inform us the thundercloud was unusual (but not unique) in that in addition to the usual green chlorophyll, the leaves contained two other kinds -- xanthophyll and anthocyanin -- which do not fade during the course of summer. Similar pigmentation can be found in unusually colored seaweed.

This explanation, which Ali remembered for far longer than I would have imagined, is to me relatively trivial. What was important was allowing her to observe how we, as adults, went about ferreting out information.

A more momentous question was posed several months later. We were driving to a rural market to buy fruit for autumn canning. Ali was staring pensively out the car window as she was wont to do, when she inquired suddenly, "How does the tree know when to drop its leaves in the fall?" I paused for a bit longer than a moment, trying to judge the level at which to address the question and recognizing my own ignorance of the actual biological mechanism for tree thought. "Every living cell has a map and a clock inside," I said, "and knows exactly what is supposed to happen next. The cells communicate with each other so each knows what to do and when to do it, just like the cells in your body. The map and alarm clock are called DNA -- deoxyribonucleic acid."

Ali provided the necessary corrective to my earlier miseducation efforts oriented around the naming process and, to be fair to myself, I did call attention to the characteristics of trees as well as naming them. And the labeling process is in fact important to the young child. As Joseph Chilton Pearce noted in his classic work *Magical Child*, naming provides the child with a common experiential ground which she shares with her parents, and allows them both to refer to objects and experiences not manifest in the present moment. Through the naming process, parents grant sanction to a child's experience, and the shared process reinforces the parent/child bond, the secure underpinnings for future exploration. At any rate, Ali did learn tree names, but she didn't allow the name game to get in the way of her growing powers of observation, her knowledge quest, or her empathic understanding. After Ali turned 6 1/2, we contemplated an 80-foot tall evergreen a block away from our Olympia home. We tried the tree identification book, but all we come up with was a giant sequoia (*Sequoidendron giganteum*). But we never heard of a giant sequoia outside of southern California where we had just stopped on a recent car trip to Mexico to see the General Sherman tree at Sequoia National Park. I told her I thought a sequoia unlikely. Undaunted, Ali carefully gathered up a cone, a small branch, some needles, and a piece of bark, placed them in a plastic bag, and took them on a trip to Washington, DC, to visit her grandmother, who volunteers as a Smithsonian Institution docent. The two of them took the bag to the National Arboretum where they left it overnight. In the morning they received a phone call informing them that it was indeed a giant sequoia, and that cones had been brought to western Washington by settlers from California in the 1880s. Tree identification opened up into a series of lessons on plant geography and 19th century history.

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I am aware of the emphasis public school systems purport to place on computer skills and technology as the basis of "education for tomorrow". Anyone familiar with the failures of the school system to teach basic math to large numbers of children using pencil and paper will remain justly skeptical. Regardless, to my way of thinking, this emphasis is misplaced. In an increasingly crowded world, with escalating competition for finite resources, and the degrading of the environment, I believe all education should be grounded in an understanding of and respect for the natural world.

Fortunately, my experience of children is that they unconsciously, and for different reasons, see it the same way. So much of early childhood is made up of coming to an understanding of natural processes and becoming competent in dealing with the physical world that I am convinced such learning becomes the template for later knowledge quests in a broad array of areas.

I envision the cornerstone of a sound environmental education to be based on five principles and processes:

- Preserve the child's sense of wonder and enchantment (this is by far the most critical);
- Allow the child's anthropomorphic tendencies to atrophy while at the same time reinforcing the child's sense of kinship with the natural world;
- Emphasize the environmental requirements for nature to thrive, and the fact that humans have these same requirements;
- Create understanding of the partnerships, the symbiotic relationships, which occur within the environment, and the cycles of birth and death; and
- Nurture the child's sense of belonging, ownership, and responsibility.

With our gentle assistance, I have witnessed all five of these processes develop as part of our children's ongoing interactive dialogue with the natural world. My caution is that this dialogue, like natural processes themselves, takes time, and should be respected. We have found a few well-thought-out and well-placed questions at the appropriate moment to tune young children to be receptive may be all that is necessary to further their own explorations, rather than an elaborate curriculum.

Our success in fostering this inner dialogue was demonstrated to us by one of Ali's first forays into poetry:

The Trees of Peace

The trees of peace,
The trees of the beasts,
They are so tall and green,
That nothing behind them can be seen!
What is behind them is as dark as night,
But in the trees it is very bright!
The trees of peace,
The trees of the beasts,
Of the promises they make,
They promise to save us,
From storms and floods,
Rains and winds,
And bring us good forever.

Through our learning adventures, we watched Ali, and later Meera, incorporate science and the natural world into their psyches through poetry, rhythm, and image. Indeed, these may provide the vital matrices necessary for having a young child take delight in her growing sensitivity and understanding of the natural world. The key word here is "delight", for it is that same delight which

will be felt later by the lover reading a poem while lying under a tree in the hush of falling leaves, the scientist finding romance in the newly discovered DNA pattern of a segmented worm, or the amateur musician softly singing to herself while alone in the garden as the late afternoon sun fades away.

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Much has been written regarding children's relationships with animals. I suspect young children initially experience animals as little different from themselves. Like children, animals eat, drink, breathe, explore, run, crawl, sit, climb, fear, defecate. In fact, very young children may find more in common with a family dog of similar size, sharing their four leggedness (though not their locomotive skill), than they do with two-legged, six-foot tall, bearded creatures, claiming to be relatives, who make a fuss over them and might even feel compelled to toss them in the air. This provides a tremendous advantage in the learning process if exploited thoughtfully. As the development of all animals is telescoped into a much shorter time period than that of humans, it provides a welcome analogy for children working hard to understand their own biological development. Children are also quick to draw analogies from the variations which occur as a result of animal evolution.

We saw an interesting expression of this readiness to draw analogies before Ali turned 3. Ali developed a keen interest in whales and dolphins, I guess from an early bathtub companion, as she was yet to be exposed to "Flipper". As a gift from an uncle, she received a set of 18 anatomically correct plastic whales, nine adults of different species and nine babies. As one might expect, in her play she would often arrange these in their respective pairs, or divide the adults and babies into two groups. What we didn't expect is that after a brief explanation that there were two major whale varieties -- baleen and toothed -- Ali started separating them according to their culinary habits as well as their biological development: the toothed eating fish, and the baleen dining on "little shrimpies and krill". Culinary discrimination is an important unfolding in the lives of young children, as is the capacity for chewing, so there is really little wonder that Ali would latch onto an analogy for them in the natural order. We were later able to encourage this fascination with whales by visiting, on a rare car-camping vacation, the gray whale breeding grounds at Guerro del Negro in Baja California, Mexico (you can actually touch them!), and with a whalewatching trip out of Boston Harbor when on the East Coast for the gift-giving uncle's wedding. Ali's first serious subject of study was cetacean biology, and prompted another early poem:

The Humpback Whale

Peaceful whale,
Graceful whale,
How I love the humpback whale.
She swims with her fins,
And dives with her tail,
How I love the humpback whale.

Twice a month for almost a year while Ellen was in massage school at night, 5-year-old Ali, 2-year-old Meera, and I paid a visit to Northwest Trek, a wildlife park run by the City of Tacoma Parks Department. Both Ellen and I have ambivalent feelings about zoos in general, but much less so about Northwest Trek. Within clear view of Mount Rainier, Northwest Trek is set up in such a way that most of the animals -- bison, mountain goats, elk, bighorn sheep, pronghorn antelope, white- and blacktail deer, caribou, trumpeter swans, and moose among others -- can roam freely over more than 500 acres, with recreated microhabitats ranging from marsh and meadow to woodland forest and steep hillside. Humans are confined to trams traveling set routes which the animals can avoid if they so choose. Trained docents furnish information about the flora and fauna encountered. A nature center provides hands-on activities for children, and displays several native snake species, freshwater fish, butterfly habitats, and living bee hives. Small numbers of once-injured but now partially rehabilitated birds of prey -- bald and golden eagles, barn, snowy and great horned owls -- are kept in open air enclosures, as are several small mammal species, from skunks to wolverines. All animals at Northwest Trek, except a few wild turkeys, are native to the Pacific Northwest. We have since visited a similar center, Homosassa Springs State Wildlife Park, north of Tampa, Florida, a rehabilitation home for injured manatees as well as a refuge for alligators, flamingos, foxes, and the endangered Florida panther.

The three of us would usually take the 45-minute journey out to Northwest Trek in the early evening, often taking a picnic dinner with us. The educational advantages of frequent visits became apparent very quickly, and contrasted sharply with one-time visits we have paid to much larger zoos or nature theme parks over the years. During these visits, children (and grown-up children!) are for the most part attracted and wowed by what they consider (or are *taught* to consider) to be the most unique and unusual creatures -- the largest (elephants and giraffes), funniest (monkeys and hippos), most ferocious (lions and tigers), cuddliest (pandas), most entertaining (dolphins and seals). The areas where these are located receive, pardon the metaphor, the lion's share of the traffic. Information about habitat, geographical range, food gathering, reproduction, raising of young, or group behavior might at best be displayed on signs written in print too small for a child to read. Details regarding the interrelationships among animal communities and between animals and plants in the natural environment -- predator/prey, symbiosis, parasitism -- is rarely offered. Parents would have to work very hard indeed to remedy this deficiency to a child who is receptive while at the zoo, assuming they had such information at hand. A naturalist ready and able to answer questions from both children and adults is seldom available. But the biggest shortcoming of all is the failure of zoos and theme parks to convey to the one-time any sense that animals, like humans, experience full life cycles -- they are born, raised, learn, grow, mate, and die. Instead, the animals are static: the zoo lion sleeping under his tree is but a "life-like" virtual reality representation of the animated cartoon version. Even if one undertakes a return visit, the animals are more likely than not to appear exactly the same, as if stuck in timewarp. They might just as well be well-programmed robots.

This sensationalist but non-dynamic presentation of the animal world seriously shortchanges the intelligence and intellectual curiosity of even young children. In my experience, children as young as 2 1/2, are prepared, even eager, to take in information on animal behavior and development, much as they do information about the human world around them, provided they are appropriately exposed to it over time.

During the course of the year, Meera and Ali made Northwest Trek a second home. They befriended all the docents, nature center volunteers, and tram drivers who looked forward to seeing them, and were often invited up into the spotter's seat beside the driver to look for animals and help answer the questions of other visitors. Within six months, Meera could confidently identify the animals to be found in each of the microhabitats: swans, Canada geese, and beavers by the pond and in the marshes; bison and pronghorn in the fields and meadows; elk, caribou, and deer in the woodlands; mountain goats and bighorn sheep on the slopes. Ali discovered that baby bison and elk were born in the spring, that older males did not travel with the herd, and that they marked the mating season with ritual displays. She learned that caribou antlers, made of living tissue, grew into velvet, and fell off, but that animals with horns, which are made of non-living material as are fingernails, never lose them.

For both Meera and Ali, the most exciting part of each trip was the search for the moose, only rarely successful. They learned the moose bedded down around the swamp cabbage or hung out deep in the woods in summer, and trained their eyes to peer more carefully as nightfall approached and the weather cooled. A sighting would be great cause for celebration. They observed bison put on their winter coats, and mountain kids grow from nurslings to adulthood. They both relished sharing the bison's Latin name, *Bison bison*, earnestly informing new visitors that these are *not* buffaloes, which are a completely separate Asian species. Both Ali and Meera attended short summer camp sessions at Northwest Trek, and Ali was invited on a special trip into the free-roaming area with one of the caregivers to feed the animals. By the time each of them turned 6, Ali and Meera had more direct experience and understanding of the animal world than I had in a lifetime before they were born.

All Ali wanted for her fifth birthday was a snake. I presume she got the idea from Northwest Trek. She certainly didn't get it from me. As already noted, I'm originally from New York City, and the only pet I was allowed to keep as a child was a parakeet, and only after my mother had flushed several dead goldfish down the toilet. I'd never lived in a house with a reptile before, and rarely saw one. I think this was probably an advantage, as at least I had learned no fear.

A week after Ali insistently informed us of her desires, a young western garter snake serendipitously appeared outside our back door. The snake cooperated uneasily when I picked her up and placed her in the five-dollar terrarium we'd purchased at a neighborhood yard sale the day before. Ali was pleased, in her own quiet way. She spent hours watching the black rope of an animal with narrow green and gray ribbons running down her back and sides. We called her Olympia. Meera squealed with joy when Ellen allowed Olympia to curl around her wrist or slither up her arm.

One evening I returned home late from work, tired, but still wanting to take the family to a community event. Ellen suffered from a bad cold, and both kids were out of sorts, but I still had hopes, when we discovered Olympia had escaped! After 40 minutes of hunting with flashlights, the children in tears the entire time, we located Olympia hidden in the refrigerator coils. Many wrenches and screwdrivers and much pushing and shoving later, Olympia was back in her terrarium, both kids in bed, and Ellen and I sitting in the family room, drinking tea. A psychologist friend later informed me that Olympia, as a family member, was correcting an imbalance that night in the functioning of our family system.

Olympia did not eat well in captivity despite our best efforts, and we all agreed to let her go. For several years, whenever Ali and Meera saw a garter snake in the backyard they would greet it as Olympia, their long-lost friend.

Olympia was soon replaced by a one-year-old cornsnake named Pop. Pop enjoyed slithering up inside people's shirts and blouses, and had a very placid disposition. One of Ali's favorite activities was to allow Pop to wind himself through her long, dark hair and then to walk around as the family Medusa, to the consternation of visitors to our home. Alas, Pop didn't stay with us long. He escaped one evening from his terrarium and hasn't been seen since. For awhile, we found diversion in warning squeamish house guests that if they discovered a snake in their bed in the middle of the night, (having emerged from the heating ducts), to tell us immediately so we could celebrate his return.

Ali's next two reptiles were also cornsnakes, Tassel and Silk. "They're both mutations," Ali would lecture any adult visitors prepared to listen. "Tassel, the male, is amelanistic ('without black', meaning a red and white mutation for a corn snake), while Silk, the female, is amelanistic, anerythristic ('without black or red', meaning white)." Then she'd launch into a learned dissertation of the potential genetic makeup of their future offspring, an understanding of which had been sparked by conversations with Sam, our local pet store snake breeder. Most of those on the receiving end of the lectures appeared genuinely mystified and noticeably ill-at-ease, as adults are not in the habit of taking in and evaluating scientific information offered by 6-year-olds, and were rarely prepared to admit ignorance and ask her to explain things in terms they could understand. Ali learned how to do Punnett squares, simple charts displaying future genetic possibilities, prior to two-place addition and about the same time she learned to read. Discussions of reptilian DNA were had by all, as well as interesting conversations about nature versus nurture. Ellen's massage school biology and knowledge gained from my professional work in public health stood us in good enough stead. After attending a reptile fair in Seattle, Ali joined the Pacific Northwest Herpetological Society as their youngest member, and has helped with reptile shows at the local library. Both kids took to giving away snake sheds as gifts to delighted friends.

Ali developed a somewhat annoying practice of correcting scientific or other misinformation offered by others within her earshot, whether solicited or no, and it took some doing on our part to at least tone down if not cure her of the habit. It was especially difficult as she, in contrast with Meera, never did so in order to show off. She simply assumed everyone would want to have access to correct intelligence about just about anything, just as she would herself. Ellen explained to her that this practice might make some people feel uncomfortable, and she should curb the urge, at least around her friends. Ali still struggles with this. She has managed to learn to control herself, but says hearing wrong information stand uncorrected continues to "drive me crazy."

When Tassel and Silk arrived, they were only three months old and eight inches long. Watching them grow to their current four-and-a-half foot lengths turned out to be a great learning tool, and an introduction to the science of measurement. Each month after they shed, Ali or Meera measured the skin length and weighed the snakes on a balance scale. Then we plotted the weight and length on graphs hung above the enclosures.

Not long after we acquired the two snakes, my daughters were given two rats -- one male, one female -- by one of their friends. Nightingale Ocean and Snowflake came with a solemn pledge:

their offspring could not become snake food. That day should go down in rat history like the Emancipation Proclamation. Close to a hundred rat babies were raised and sold to the local pet store, which paid us enough to feed the next litter. Meera took on the role of official baby rat handler, so that when the 6-week-old rodents made it to the pet store, they fetched a premium as hand-tamed. Meanwhile, we warn house guests that if they go looking in the freezer for a late night snack, they shouldn't take *all* the frozen microwavable mice. Tassel and Silk will not be pleased. We've now taken to raising fresh white mice for the snakes' dining pleasure. In our house, mice are totem, but rats are taboo.

After being introduced to them at a Herpetological Society meeting, Ali told us she wanted to spend her savings on an Eastern Box Turtle. "Really a tortoise," she insists authoritatively, and who am I to argue? Terra Rosa, a 5-year-old female, arrived just in time for one of our town's biggest annual events, the Olympia Pet Parade. Almost a thousand people gather with their pets in our downtown area and compete for prizes offered by local merchants. Then they march up our main street to the cheers of the multitude, led by a troop of bagpipers, horses thoughtfully assigned to bring up the rear.

We taped a fan of white feathers topped by a single peacock feather in the center to Terra Rosa's back, and a few stray feathers to the sides like a fringe. Then I helped the kids rig a sign for the back of their wagon, reading "Rare Olympia Peacock Turtle - *T. Olympianus Ridiculi*". When Ali and Meera, dressed in their Halloween wolf costumes, pulled the wagon up to the judge's area, we knew we had a hit. Children and parents gathered round, and among the ferrets, snakes, guinea pigs, bunnies, goats, geese, ducks, dogs, cats, and tarantulas, the judges awarded Terra Rosa a cash award for best animal costume. It was just enough to purchase a second box turtle for Meera, a male incongruously named Fluffy. Terra and Fluffy both enjoy eating bananas and flopping around in the bathtub.

For my birthday, the children informed me that the family room was being converted into a nature center. A sign written in a 6-year-old's scrawl appeared, tied to the tree outside the house, proclaiming "This Way to Fun", with an arrow pointing toward the door. Ellen built a floor-standing terrarium made of 2 X 4s and an old sliding glass window, which now housed Terra Rosa, Fluffy, and a male green iguana named Mendel after the founder of modern genetics. (The Latin is *Iguana iguana*, Ali reminds me, paralleling *Bison bison*.) In and around the nature center are or have been two turtles, two iguanas, 40 white mice, 22 rats, two black-masked lovebirds -- so similar ("'Monomorphic' is the word," says Ali) we named them Victor and Victoria, to Ali's great amusement (she had loved the Julie Andrews' movie after having it thoroughly explained by us) -- and a host of offspring, a green-cheeked conure (a little parrot) who likes to help us wash dishes, a Holland Lop rabbit, a Catalan sheepdog, and a group of inscrutable Asian stick insects. Caring for them all became part of the family regimen. Meera and the reptiles became regulars at various show-and-tells about town. I am still allergic to cats.

Even before Ali could read by herself, the thread of earlier exchanges about DNA and mutations led us into fresh discussions about biological adaptation. "Would Silk -- the amelanistic, anerythristic (that is, white) cornsnake -- survive in the wild?" "Yes, and more likely if she could find white sand to hide in." "What about Tassel, the amelanistic red one?" "His chances would increase if he could live around red clay soil." "What about white tigers?" "Where it snows a lot."

"And pink ones?" "Are there pink tiger mutations?" "No. But if there were, they'd be valued for television commercials." For months and even years, our dialogues about biological adaptive and survival values have deepened, even to include animal instinctive and behavioral characteristics, and those of humans as well. Enrolled, as already noted, two half-days a week in the school district's Program for Academically Talented Students, Ali chose to write a long essay on Darwin's theory of natural selection. At our suggestion, she learned "An idea is a greater monument than a cathedral," the climactic oration delivered by the character portraying Clarence Darrow from Jerome Lawrence and Robert E. Lee's *Inherit the Wind*, a dramatic rendering of the 1925 Scopes "Monkey Trial". By the time Ali reached 9, I was struggling to keep up with her in this area, and could only do so by delving into the works of contemporary Darwinists such as Oxford University's Richard Dawkins (which I thoroughly recommend). But Ali's powers of observation kept her one step ahead. I learned the theory, but when I tried to illustrate the complexity involved in the evolution of spider webs, I found out that she'd not only read about it, but had conducted simple experiments by throwing heather flowers onto different parts of various webs to see how different spider species would move around the various web strands.

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As a birthday present, my coworkers bought me a membership in Wolf Haven International, a sanctuary for captive wolves who had been used in scientific experiments or which people had tried unsuccessfully to keep as pets. This internationally recognized facility, which also sponsors educational programs and is involved in a national Mexican wolf breeding and reintroduction program, is located in Tenino, Washington, only 16 miles from our home. Yet it took about six months after receiving the gift for me to bring the family there to visit, which is a fair indication of my own initial lack of interest. Five-year-old Ali was immediately and absolutely captivated, whether by the alertness of the wolves' eyes, the eeriness of their howls, or the information or enthusiasm offered by the tour guide. Ali was pleased to offer hypotheses to several adults on the potential adaptive value of mutations in wolf eye color as the tour guide listened open-mouthed. On weekend evenings in summer, Wolf Haven International plays host to "Howl-Ins". Storytellers and musicians entertain children and adults alike. There are arts and crafts and education exhibits, and visitors and staff try to provoke the 40 or so resident gray wolves and two coyotes into howling. We began to attend regularly. For one of these Howl-Ins, Ali wrote a lullaby which she sang, and later adapted for her violin. The chorus went:

When the night comes,
When the moon rise,
Then the wolves come
To sing us to sleep.

Upon returning home that evening, Ali began to badger us: she wanted to be a Wolf Haven volunteer. Three separate inquiries over a period of months netted little response. Finally, I wrote to Wolf Haven International's founder and president, noting they would be gaining the services of our

entire family, and Wolf Haven would profit greatly by having a child work with other young visitors. The president got back to us and said if Ali would take the same required 16-hour course in wildlife ecology and wolf biology, and pass the same written examination, Wolf Haven would accept her volunteer services.

Ali, now turned 6, was game. She sat through the two-day course with two dozen other potential volunteers, all adults up to age 70, but without taking any notes -- she couldn't write yet. A week later she took the exam, which was made up of 20 long-answer questions, dictating her responses to us to be written down. "She passed," said Beth, the volunteer coordinator, "and actually did better than some of the adults."

Safety issues precluded Ali from becoming a tour guide, and she was not mathematically equipped (or tall enough!) to help out in the gift shop. Beth found the perfect position for Ali. She would assist the education director in setting up and running the education table and educational displays at Howl-Ins. Ali had to learn to furnish information and explanations fluently to both children and adults about all of the following: the diverse North American wolf species and their geographical ranges; pack behavior; hunting and feeding habits; territorial marking and migration; predator/prey relationships; sensitory acuity; breeding; biological development, and population variation and control; wolf/human relationships and myths about wolves; wolf reintroduction efforts; and the role and contribution of Wolf Haven International. Ali mastered all this information through classes, films, and books, and learned to present it by apprenticing to the education director.

Within a year, Ali ran the education table herself. She'd set up skulls of bears, wolves, coyotes, and mountain lions to explain the dissimilarities in their dental and jaw structures, and to elucidate differences in their respective faculties of smell and sight. "If you were a wolf, you could smell your mother's spaghetti sauce cooking six miles away, if the wind was right and your mother cooked spaghetti," was one of her favorite illustrations. Small canisters with cottonballs soaked in scent-producing materials of various concentrations demonstrated the acuity of wolf olfactory sense. Plaster casts of bear, bobcat, wolf, and coyote footprints showed how animals could be identified from the tracks they left. Sample radio collars, old and cruel leg-hold traps, antlers and horns of wolf prey, and pictures of animals in their natural habitat were set up and displayed on all sides of the large table. A choice hands-on activity led by Ali consisted of a plastic hotdog and pieces of carpet pads that could be affixed with velcro over elbows so they couldn't be bent. After the pads were attached, Ali would request participants to keep their hands in fists, and then try to figure out how they might manage to get the hotdog to their mouths while on all fours. Participants realize quickly that by necessity wolves are very messy eaters!

Ali's most significant innovation was her use of a set of small plastic wolves and a larger plastic caribou to spin an elaborate yarn about pack hunting behavior. Included were scientific explications of the roles played by various pack members, eating habits, hunting techniques, and the basics of wolf-related population biology, all woven into a child's 'toy story', which could be quite gripping. Ali learned to direct questions she couldn't answer herself to the facility's research director or one of the more experienced tour guides.

Since Ali began her work at Wolf Haven International three years ago, several other children have become volunteers. Ali has taken her display into school classrooms, and helped promote Wolf Haven International at county fairs in the area. Wolf Haven started an "Ask Ali" column in its

children's newsletter.

The educational value of Ali's involvement in Wolf Haven is incalculable, and the benefit of her finding ways to make use of her newly acquired knowledge cannot be overestimated. The learning process put her in direct contact with research scientists, wildlife experts, and a devoted cadre of adult volunteers who shared her preoccupation and provided camaraderie. The repetition of activity at the education table, at least twice a month, allowed her to master both the information and the entire situation as teacher, and gave her room to express her own creativity and the opportunity to share her enthusiasm with young and old alike. The subject matter itself led to broader and deeper reading and study, progressing rapidly over the years.

I need to emphasize that while we provided the initial opportunities for it to develop, this interest in wolves and wildlife ecology is Ali's, not ours. She has been the leader. Ellen's and my main contribution has been to listen, and to open doors. Again and again, I think back on what might have happened or, more to the point, what might *not* have happened if I did not follow up after our third rebuff from Wolf Haven with a letter. Similar instances of Ali and Meera sensing and then communicating their own particular learning needs, and then our strategizing ways to meet them regardless of barriers based on their chronological ages, have been a continuing feature of their education.

Victor and Victoria, the black-masked lovebirds, happily turned out to be male and female, and have produced many offspring, most of which we sold. Meera looked into their nest daily to check on the eggs, and was entertained by watching the development of the young from scrawny hatchlings to fully fledged adults in six weeks. "They're altricial," explained Ali, utilizing a word I'd never heard before to apprise me of baby lovebirds' complete dependence upon their parents, in contrast to other birds who are precocial and can fend for themselves almost immediately birth, such as ostriches, chickens, or ducks.

Ali got her new words from a book I bought for her when she accompanied me to a large bookstore in Portland, Oregon. Unlike me or her sister, Ali hates to browse, in either bookstore or library. She will withhold judgment on a book until she has read at least two chapters. But the cover of *The Lives of Birds: Birds of the World and Their Behavior* by Lester Short, Curator of Birds at the American Museum of Natural History, caught her attention, and by the time we left the store, she had read just under half of it. For days, Ellen and I received impromptu lectures about the imprinting of newlyhatched Mallards, the egg-laying of Eurasian Cuckoos, whose eggs, laid in the nests of other birds, mimic the host species' eggs in color and markings, the abstract reasoning of Blue Jays, the polygyny of Lark Buntings, and the flight navigation of Lesser Black-backed Gulls.

Needless to say, questions arose: if the Arctic Tern spends most of the year migrating, when and where do they lay and incubate their eggs? The book didn't say. With my assistance, Ali came up with several hypotheses: the mating Terns stay behind one year; or stop in the tropics in the middle of migration; or the eggs have an extremely short incubation period and the chicks mature very quickly (this is the correct explanation.) No amount of library research or queries of birdwatching friends netted an answer, so, with our encouragement, Ali struck up a correspondence with Dr. Short who provided one. This process of reading and observing, questioning, theorizing, and then researching, utilizing not only books but finding knowledgeable individuals who will take the time to respond has become a continuing feature of Ali's education.

Ali retained her capacity to draw out distinctions from earliest childhood. "Ostriches and wolves are completely different in breeding habits," she announced to us out of the blue one day. "How so," I asked, knowing I was in for something special. "Well, the main female ostrich scoops out a hole in the ground for her eggs, but several other females lay their eggs in the same hole. The male (ostriches are polygynous, she noted) will sit on the eggs at night, and the main female does so in the daytime. And when the eggs hatch, the babies are precocial and can pretty much fend for themselves. But with wolves, the pack prepares the den, only the alpha female gives birth, and many different wolves care for the helpless pups until they are ready to join the hunt."

Ali pointed out to me that there are few animals which seem to recognize their parents throughout their entire life cycle. "Just some primates, orcas, and sperm whales, although we don't really know for sure. A dead 13-year-old-sperm whale was found to have milk in its stomach. Orcas live in the same pod as their mothers their entire lives, but they always breed with one from another pod. That's how they prevent inbreeding." To ask a question about parent recognition in the animal kingdom had never occurred to me, but it is easy to appreciate why this would interest a 9-year-old growing into independence.

As she raised one of the hatchling lovebirds as a pet, Ali became interested in the degree to which animals can reason and express emotions in the human sense of the terms. She was particularly amused with my retelling of the proof offered by 19th century American philosopher Charles Sanders Peirce. Peirce noted that when his father came home from work, closing the door and throwing his umbrella in the hallway rack, the family dog would come running down the stairs to greet him excitedly. A pet parrot learned to imitate the sound of the door slamming and the umbrella dropping and would cackle with malicious amusement after causing the dog to fall all over itself scrambling down the stairs to greet its non-present master.

Meera enjoyed the menagerie, her experiences at Wolf Haven and Northwest Trek, and the flurry of activity surrounding her sister's interest in botany and animal behavior. But her early biological science interests were oriented toward people. She wanted all the details of how my brother lost both legs in an automobile accident, the details of his care, how his prosthetics were made and how they worked. At age 6, Meera's trip to the doctor for vaccinations prompted a round of questions: what diseases did each of them prevent and what are their symptoms, how do immunizations work and can they make you sick, do these diseases exist in other countries, and what really causes them? As I work in public health, these were questions I was better prepared to answer, together with an explanation of what I did in my job. She asked about the major causes of death among dogs. She inquired after one of our friends, a recovering alcoholic. "Will she die if she has one drink? Two? Well, how many would it take?" "Why do people smoke if it makes them sick?" Meera enjoyed brief periods looking at blood cells through the microscope, but she really wanted to know how diseases were transmitted from person to person and how they could be prevented.

We sought outside avenues to order Ali's natural science studies as they were growing beyond our capacity to organize them well. Ellen made several failed overtures to the local school district to see whether Ali, now 9, could sit in on a high school biology course. So we enrolled her in a high school life sciences course offered by the University of Missouri's Center for Distance and Independent Study. Several times a week, Ali reads her textbook, and Ellen and she review the

discussion and workbook materials. Ali completes a review quiz which she sends to the University. An evaluation is returned, with detailed explanations of any questions she answers incorrectly. Ali has developed her own mnemonics for nucleotides, and she has taught me about how mitochondria are used to study genetic history.

When Ali commenced the course, we were not concerned about whether she would succeed. I did have some small initial concern, however, that her independent inquiring frame of mind, which we had so carefully nurtured, might be stifled and she'd become slave to the text. I needn't have worried. From her room as she studied the very first chapter, we heard Ali splutter aloud, "That's not right." "What's the problem, Ali?" I asked. "My textbook has a big mistake. It says, 'In 1975 the United States sent the Viking space mission to our nearest planet, Mars, to see if life existed there.' But the closest planet is Venus!" I couldn't have devised a better object lesson myself if I'd tried, and we reinforced the lesson by having Ali write both the textbook publisher and the instructor at the University of Missouri. Just prior to her mid-term, I took her out for a snack at a local café. She looked at me, blueberry muffin only half-chewed in her mouth, and mumbled, "You know, dad, I wish my biology textbook was more up-to-date." "Oh, how so?" "Well, it includes statements about organelles as only hypotheses which we now know to be true." I shrugged, muttered something about the progress of science, and looked up "organelle" in my out-of-date dictionary as soon as I got home.

A final concern we had with Ali undertaking more formalized study was that pursuit of evaluation (i.e., grades) might replace her love of the knowledge quest. Fiercely competitive, I can remember that happening to me, and it took years (decades, actually) for the damage to be undone. We hoped success would come to be defined by the self-fulfillment she would experience in new learning, rather than by the number of questions she might not answer correctly on an exam. Again, we needn't have worried. On the day Ali chose to take her course final exam, she went into her room to spend half an hour on last minute review. She emerged an hour and a half later. "What have you been up to?" asked Ellen. "Well," she said, "I quickly finished studying for the test, but the material in my textbook for next semester's course (on organic chemistry and genetics) was so interesting, I couldn't stop." She completed the 90-minute final in 20 minutes, and went back to her reading.

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One of the most obvious realities about school-based education, and also one of the most overlooked, is that it takes place almost entirely indoors. Pets are excluded. Plants are prohibited for fear of potential allergic reactions. Classrooms and hallways are repeatedly treated with toxic chemicals to eliminate pests. Windows, when they exist, are kept tightly closed and secured, and are not meant to be peered through. It is as if for education to happen, nature must be shut out at all costs, for it cannot be controlled and does not conform to the school's architecture, administrative structure, or timeframes.

The result, not surprisingly, is an overwhelming natural illiteracy among children and, later, among adults. Intimacy with nature is denied. The natural world is to be dissected, analyzed, experimented upon, but there is no room for cultivating the art of long-term and continuous

observation, something for which children are well- or, I should emphasize, *naturally*, even uniquely, equipped. The fundamental lesson inculcated in children in this restrictive environment, regardless of curriculum, is that nature is, above all, foreign. At best, the natural world is viewed as a giant amusement park; at worst, as an overgrown golf course waiting to be tamed.

It is also disposable. Many schoolteachers recognize the need to bring some representative of nature back into the classroom and may be praised for doing so. The baby chicks pecking through their shells and chirping in a box under a light bulb in the corner, the hamster exercising on the flywheel, the Chia Pets growing on the windowsill, all introduce their small elements of welcome chaos into the classroom environment. Some schoolteachers can regale one with stories of just how much chaos is involved in figuring out how to dispose of the chicks once they have outgrown the box (and the classroom) or who will care for the hamster during spring break. But nature illiteracy even shows through these well-meaning efforts. There are now programs that encourage schoolteachers to hatch monarch butterflies in classroom terrariums and release them to the wild. They come in kits. No thought is given by these teachers to the fact that the monarchs released in Washington State are grown from larvae bred in New York and Pennsylvania with different genetic migratory programming. There are potentially devastating ecological consequences to the monarch species and predators and plants along their migratory paths if and when interbreeding with local stocks occurs. Regardless, students are not permitted as part of their education to take the time to observe caterpillars or butterflies in the wild, or anything else for that matter. Children, too, are part of nature, and the fear is that they too cannot be controlled.

Nature illiteracy and lack of intimacy with nature has enormous social and environmental consequences. The effects of toxic waste, pesticides, automobile exhausts, and polluting energy-inefficient production practices upon our air and water and, ultimately, upon our health and that of all living things are at least partially a result of habits of mind grounded in school-based education. Despite our own natures, we learn from an early age to ignore our intimate connection in the web, and as a society we are paying an immense price for it.

The answer to this natural illiteracy, however, does not lie in attempting to inculcate a love of nature in our children, or at least not directly. This is despite the fact that the best aspects of adult initiatives for environmental conservation and rehabilitation are driven by such a deeply realized attachment. For a young child, love of nature is a pretty abstract idea. Children aren't born with an instinctive nature affection, but freed of indoor tyranny and gently nurtured, they are more likely to find an affinity with nature deeper than their elders can ever hope to reclaim for themselves. In our experience, time in nature provides the grounding, but nature education best proceeds from the specific to the general. Kids may not make sense out of the idea of loving nature, but they may become very attached to their own, sometimes secret, places. They might not feel a generalized sentimental affection for all of creation, but they may become obsessed with ants, spiders, mushrooms, horses, or, yes, even dung beetles. Feed the child's chosen nature quest, and she will find herself intimately entwined. Still, and it is an open question: can people, and especially children, who are now living more and more isolated lives indoors, and who are losing their stories, tales, myths, and experience of the wisdom and power of the natural world, nevertheless learn to honor and protect it?

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Even as Ali was completing her life sciences course, she spent increasing amounts of time on daily jaunts to the 25-acre woods in our neighborhood. Equipped with magnifying glass, binoculars, plastic bags, nature guides, occasionally a journal, or, more commonly, just waterproof boots, she quickly became the resident naturalist. She also joined the local chapter of the Audubon Society so she could go birdwatching. I got to tag along on trips which we now schedule weeks in advance. With chapter members averaging more than 45 years of age, and some with decades of experience, each excursion provided Ali with 12 to 15 knowledgeable teachers ready and eager to explain bird behavior, identify wildflowers and mushrooms, discuss butterflies. Critically, and unlike many similar adult-oriented settings in which she has found herself, birdwatchers understand and appreciate the value of silence and contemplation. Nature itself is the best teacher. We purchased a 'birder's lifelist', a journal and checklist which includes the 720+ bird species native to North America, as well as space for observation notes. In an expression of humor absolutely typical of her, Ali used one of the blank spaces on the list to report sighting an astronomical object, the Wild Duck Cluster. The lifelist is an important educational tool. It provides Ali with a working reminder of how much more there will be to observe and learn throughout her lifetime. Audubon outings and meetings have become elements of Ali's life sciences learning lab, but have not displaced her tireless efforts to catch the gilded leaves from the alder tree outside our home as they cascade in the autumn wind.

There is a recurrent theme running through our natural science adventures, but one which rarely becomes apparent in the school process of stuffing children's heads with disconnected facts whether they express interest in them or not. Namely, the first duty of the naturalist, as of all scientists, is to describe accurately what one has perceived, and to communicate it within the context of a growing understanding of the larger natural order, both for oneself and for others. This can be taught formally, but our experience suggests it doesn't have to be. What is required is for the child to acquire the tools and opportunity to make explicit what is already going on in the evolving journey of self-awareness, of which nature awareness is an integral part. Long after their discoveries have been superseded, the writings of the great natural historians and scientists, like the knowledge quests of children, continue to engage and inspire because, ultimately, they awaken us to something enduring about ourselves.

What I hope my children have gained through our learning adventures is a deepening recognition that the process of science itself is a conversation, with the world of natural phenomena of course, but also with scientific understandings of the past, with our perceptions and those of others around us, and with the future. It is this dynamic of conversation, its inherent reciprocity, which coaxes nature to yield up her secrets, as to an intimate friend. To quote from *The Dispersion of Seeds*, the last work of America's greatest naturalist Henry David Thoreau, which I gave to Ali when she embarked on her high school life sciences course:

> Though I do not believe that a plant will spring up where no seed has been, I have great faith in a seed. Convince me that you have a seed there, and I am prepared to expect wonders.

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Brown, Tom and William Jon Wilkins, *The Tracker: The Story of Tom Brown, Jr. as Told to William Jon Wilkins*. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1978. The first of many books by and about Tom Brown, revealing a timeless wisdom about the natural world and our place within it. I think Ali has read just about all of them! This book cannot fail to fire the imagination of young and old alike. In Washington State, we are privileged to be home to the Wilderness Awareness School, founded by a student and close apprentice of Tom Brown. The School is a community-based institution dedicated to engaging humans' natural intelligence and awakening our innate abilities to perceive and connect with the world around us. Wilderness Awareness School offers programs lasting from several hours to a period of years. Its Kamana Naturalist Training is a comprehensive program, offering a sophisticated inquiry into ecology, biology, botany, natural history, ethnobotany, and cultural anthropology. It involves hands-on field work, observation, and extensive journaling, and develops life-long research skills. The correspondence program is meant for adults or teenagers, and takes between 18 months and five years to complete. Extensive mentoring and support is provided. Ali is likely to undertake the Kamana program shortly. For a list of offerings and more information, contact the Wilderness Awareness School, 26333 NE Valley Street #5-137, Duvall, WA 98019; telephone 1-800-340-6068; 425-788-1301; website: www.NatureOutlet.com; E-mail: wasnet@natureoutlet.com

Connor, Richard C. and Dawn Micklethwaite Peterson, *The Lives of Whales and Dolphins*. New York, NY: Henry Holt and Co., 1994. One of the two volumes in the American Museum of Natural History's animal behavior series ever published, and "almost as good as Lester Short's book on birds," says Ali. The series editor, Theresa Burns, upon my calling her to tell her how much Ali enjoyed Dr. Short's book and checking to see if there were others in the series, went out of her way to send Ali a free copy, now out of print.

Cornell, Joseph Bharat, *Sharing Nature with Children*. Nevada City, CA: Ananda Publications, 1979. Now considered a classic, and justifiably so. Cornell's maxim, "Share more, teach less", should be at the heart of any sound nature or science education.

Dawkins, Richard, *River Out of Eden: A Darwinian View of Life*. New York, NY: Basic Books, 1995. See also *Climbing Mount Improbable*. New York, NY: W.W. Norton, 1996.

Northwest Trek, Eatonville, WA 98328; Telephone 1-800-433-TREK; 360-832-6117; www.nwtrek.org

Penn, William, *Some Fruits of Solitude*. Richmond, IN: Friends United Press, 1985. For more than 300 years, Quakers have held a testimony regarding the importance of education, and nature education in particular. Perhaps the earliest and most poetic statement of this testimony comes from William Penn, the founder of the "Holy Experiment" which became the Commonwealth of Pennsylvania, first published in 1693. "The first Thing obvious to Children is what is sensible; and that we make no Part of their Rudiments. We press their Memory too soon, and puzzle, strain, and load them with Words and Rules; to know Grammer and Rhetorick, and a strange Tongue or two, that is ten to one may never be useful to them; Leaving their natural Genius to Mechanical and Physical, or natural Knowledge uncultivated and neglected; which would be of exceeding Use and Pleasure to them

through the whole Course of their Life...

It were Happy if we studied Nature more in natural Things; and acted according to Nature; whose rules are few, plain and most reasonable. Let us begin where she begins, go her Pace, and close always where she ends, and we cannot miss of being good Naturalists. The Creation would no longer be a Riddle to us: The Heavens, Earth, and Waters, with their respective, various and numerous Inhabitants: Their Productions, Natures, Seasons, Sympathies and Antipathies; their Use, Benefit and Pleasure, would be better understood by us: And an eternal Wisdom, Power, Majesty, and Goodness, very conspicuous to us, thro' those sensible and passing Forms: The World wearing the Mark of its Maker, whose Stamp is everywhere visible, and the Characters very legible to the Children of Wisdom.

And it would go a great way to caution and direct People in their Use of the World, that they were better studied and known in the Creation of it. For how could Man find the Confidence to abuse it, while they should see the Great Creator stare them in the Face, in all and every part thereof?"

Short, Lester L., *The Lives of Birds: Birds of the World and Their Behaviors*. New York, NY: Henry Holt and Co., 1993.

Thoreau, Henry David, *Faith in a Seed: The Dispersion of Seeds and Other Late Natural History Writings*, edited by Bradley Dean. Washington, DC, and Covelo, CA: Island Press, 1993.

University of Missouri Center for Distance and Independent Study, 106 Clark Hall, Columbia, MO 65211-4200; Telephone 1-800-609-3727; FAX 573-882-6808; website: indepstudy.ext.missouri.edu

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