

# *Clan Apis:* A Comic Book Biography of a Honey Bee

*You don't have to create any weirdness about bees. They are already weird enough...  
You don't have to be magical. They are already magical enough.*  
Jay Hosler

by M.E.A. McNeil

As Jay Hosler was excising a tiny piece of a bee's exoskeleton from between her eyes, he solved a problem. Never mind that his scientific purpose was to expose the brain, which lay just beneath, for an experiment involving olfactory memory: it was the cartoonist in him that had been looking for an accurate way to draw emotion without humanizing a bee, and he saw that she and her sisters expressed their displeasure by crossing their antennae.

It is this degree of intention and observation that makes *Clan Apis*, his collection of comic books illustrating the life of a honey bee, both a delightful read and a superb teaching tool<sup>1</sup>.

Hosler is a neurobiologist who teaches at Juniata College in central Pennsylvania. He uses science comics in courses including sensory biology, and he has demonstrated that they spur understanding.

Cartooning was a pastime that did not merge with his scientific goals until he was a postdoc at Ohio State University Rothenbuhler Honey Bee Research Laboratory. He is not formally trained in art; he started drawing dinosaurs in primary school from pictures of a plastic diorama. "I grew up emulating comic books," he said, "Drawing dinosaurs and Spiderman and Spiderman riding on dinosaurs."

He contributed comic strips for the student newspapers of DePauw University, where he was an undergraduate, and Notre Dame University, where he completed his PhD in neuro-ethology. At the same time as he was studying how the nervous system affects behavior in bees, he was drawing "the usual college humor about parties, hard courses, trouble getting a date. I didn't connect my two interests."

Later, at the Rothenbuhler lab, "I read Mark Winston's *The Biology of the Honey Bee* and thought it would make a great comic. It was not until a year later that I thought I could be the one to do it."

"The thing that has struck me about the use of insects in general is that people want to layer their experience onto them, and insects are interesting enough in themselves. They are an alien world: They don't generate their own heat; they have wings and six legs. The novelty, the strangeness of their world is the book. But they do share the planet, and we have elements of shared experience: we are born, live and die. We affect others along the way. You don't have to create any weirdness about bees. They are already weird enough. They live in a house of their own excretion. You don't have to be magical. They are already magical enough. People want to layer their own agenda on bees, making them nature's monarchy, nature's democracy -- very self-serving arguments using bees with only a smidgen of understanding. People who have another story to tell think it would be cute to use bees. They shoehorn them into human experience and strip away their natural wonder."

Long hours in the lab working intimately with the bees, studying connections between physiology and behavior, gave him an opportunity to consider how to draw them. "I was constantly looking at bees close up -- staring at their faces to assess whether they had learned, what they did with their mandibles and antennae. I didn't want to give them big camera eyes like a Disney character. I needed a way to convey emotion without changing the shape of their eyes. With humans, a furrowed brow looks mad, but I had to ask how to do that with a bee. I saw that when they didn't like something, they crossed their mandibles and antenna. The solution I came up with was to use the antenna like eyebrows to convey emotion."

True, Hosler's bees are anthropomorphized. They talk, displaying a familiar range of human traits: fear, indiscretion, loneliness, sassiness, loyalty, mourning and an inclination to pun. Give him that -- he is, after all, human, and we are not ready for a book written in buzz. Hey, it's a comic book: "Watch as Nyuki's fear of the outside struggles against her desire to leave the hive and fly. Marvel at how she gets on her sisters' nerves! Thrill to Zambur's shocking tale of honey bee love! Shudder at the lengths Dvorah and her fellow guard bees will go to defend the hive... There are thrills aplenty as our heroine faces a gauntlet of cleverly camouflaged carnivores in her topsy-turvy quest to get back to her sisters. Will she make it? All will be answered..."

But the genre is left behind by the sophistication of this book; it is more a graphic novel. The characters are well defined. Absent is the comic book villain: although a queen kills her rivals and a praying mantis attacks a bee, it is all natural -- not a question of ethics, even though the bee in question is close to our hearts. Wisecracking banter, groaner puns and scatological humor enliven scientific narrative. Page through the book without reading the words to see that each illustration is painstakingly anatomically accurate.

The book comprises a series of five comic books exploring the society of bees through the life story of a honey bee named Nyuki. The science is slipped in like spinach in a cookie. The reader learns about the life of a colony: metamorphosis, sequential roles for workers, pheromone communication, the queen as sovereign and slave, the co-evolutionary relationship with flowers, swarming and other behaviors such as cooling, piping, propolis collection, warming, tropholaxis, dance communication, pollen collection. End notes expand on the information. The overarching theme that lends poignancy is the continuity of life.

The names of Hosler's characters are words for "bee" in other languages. He first found the Swahili word Nyuki, used by a colleague to name a computer program; he then came up with Dvorah (Hebrew), Hachi (Japanese), Zambur (Farsi), Abeja (Spanish), and Melissa (Greek). He named Sisyphus the dung beetle after the mythological king condemned to roll a rock uphill for eternity. Bloomington the flower is affectionately named for the hometown of the Hoosiers, Hosler's favorite basketball team.

"I had to come up with the story," he said. "The simplest is coming-of-age -- from birth to death. It came from Winston, but it is not so much an adaptation; he was the primary source to make sure I got the bee biology right."

The plot arc begins with a bee version of the Big Bang. When an amphibious animal ventured on land "she thought she was the first bold pioneer...She wasn't." The insects, who had evolved long before, crack, "There goes the neighborhood".

Nyuki, the vehicle for the story, is a bee with a lot to learn about life in the hive and not much time to do it. We meet her as a lippy larvae questioning the nurse bee, Dvorah, who is capping her cell -- a relationship that one reviewer neatly described as Whoopi Goldberg to Katherine Hepburn:

"What did you do before?"

"I cleaned empty brood cells."

"So what happened, did you get fired or somethin'?" There ensues a narrative of how, as the bee ages, her responsibilities evolve in roles dictated by the needs of the hive and the bees' "inner voice".

Does Nyuki know why she is not hungry now? "Your weight has increased 2000 times in your five days as a larva. You've been eating so much food so that your body has the energy for the metamorphosis. The fact that you're not hungry anymore means your body is ready for the change."

To the larvae's request for a manual to undergo metamorphosis, Dvorah answers "Would you relax? You'll know what to do and when to do it because the blueprints and instructions are included in your genes. It's instinctive." And where will she get the materials to weave her cocoon? "You already have them. You weave the cocoon with silk from the spinnerets in your mouth...Early in the construction process you'll excrete the waste material that is built up during your five day eating binge. You'll use the feces to supplement the silk in the construction of the cocoon."

"You're just trying to gross me out," replies Nyuki.

The process of metamorphosis is both comically and accurately portrayed, with a chorus of "Ouch! Ouch! Ouch!" as cells divide, digest and replace the old larval cells.

By the time Nyuki emerges, Dvorah is working ventilation ("You never could hold a job."). What Nyuki supposes is her welcoming party turns out to be preparations for swarming. She learns why the queen has become "a lean, mean flying machine" and, in the "calm before the swarm" decides to join in.

She learns the role of her brother drone: "I live to die so that the clan may live."

In a touch of artistic license, the naïve Nyuki decides to leave the swarm to find a nest site on her own -- creating situations for the artist/scientist to offer context for his lessons. When Nyuki calls a dung beetle weird, he says, "That's a matter of perspective. Most living things live alone and fend for themselves. Honey bees are a rare example of animals that live and work together for their mutual benefit. Your social behavior makes you the weirdos in the animal kingdom, not us."

Eventually, the forager Nyuki dies with tattered wings at the base of her flower friend Bloomington. Spoiler alert, for this is the satisfying ending: "Now Nyuki's body will go through its final metamorphosis. The seasons will change, your flower will wilt and her body will be broken down bit by bit by an invisible kingdom of bacteria. Her parts will return to the soil where they were feed your roots in the spring. What was once Nyuki will become part of your new flower. By the time you bloom next year I

think you'll understand her plan... She planned on returning to the hive with a full load of nectar... She had figured out the cycle of things. When she said she would return with a full load of nectar, she meant the nectar would be carrying her."

Text in a section at the end of the book, called Bee Lines, details elements of the story: how bees fit into the insect world, their history, biology, nomenclature, how their size is limited by their physiology, pollination, castes, the rearing of workers queens and drones, the use of smoke by beekeepers, how an invader was attacked in the story as well as prophylaxis, pheromones and other behaviors.

A separate six-page comic is appended to the book: "Killer Bee". It tells how Hosler, alone in his apiary, was stung and went into anaphylaxis. He does graphic justice to the alarming constriction of the throat and the subsequent misery of desensitization shots.

Hosler calls *Clan Apis* "evergreen" because it was collected as a book in 2000 and is now in its sixth printing. Another word for it is classic. Its birth was serendipitous, as publishing a comic with anything other than superheroes was at best a slim possibility. But in 1998 Peter Laird, one of the creators of the Teenage Mutant Ninja Turtles, gave him a grant for the printing costs through the Xeric Foundation, a venue for artists to self-publish comics. Hosler chose the imprint Active Synapse, "because a synapse is where two nerves talk to each other." The business end is handled by his partner Daryn Guarino, who lives in Ohio. Hosler likes being free from an editor, which has allowed him to do such things as include a page of bee drawings by kids. "Since it's not my full-time gig I can do it," he said.

"It took a year to do the first comic with no kids, three years to do the next book with one child (Max, now 11) and five years to do the next one with two kids (Jack, 9)," he said. In addition to *Clan Apis*, Hosler has created *The Sandwalk Adventures*, a conversation about evolution between Charles Darwin and a follicle mite living in his eyebrow. A grant from the National Science Foundation has funded *Optical Allusions*, a series of comics exploring sensory biology. The first is concerned with the evolution of the eye and vision through the story of Wrinkles the Wonderbrain.

*Clan Apis* was a recipient of a 1998 Xeric Award and has been nominated for three Ignatz Awards and three Eisner Awards, including Best Title for a Younger Audience.

Two assumptions generally held a decade ago, when the book was written, could be corrected in future editions to reflect more recent science. On choosing a nest site: "Eventually we shall all attend to the scout with the best dance and follow her to the new nest" can be corrected to show Tom Seeley's discovery that it is a quorum at a site that triggers the decision. Also, Marla Spivak's work on propolis shows that it has a crucial antibiotic role in the hive – beyond the mentioned value as insulation and embalming.

The movement to use comics in science education goes beyond Hosler, who calls it "not science fiction but science fact" in an interview on NPR. "Comics use a shorthand to communicate ideas, and science does the same thing." He draws a stick figure on a board and then the number 2. "This figure is an abstraction. So is the number. There is no 'two' running around in the world. It's an abstraction, something we made up to represent things." He believes our brains are hardwired to understand through comics and points out that cave paintings are like comics. "What's Spiderman doing? He's just doing what every spider can do."

Hosler says that it is his goal to use his cartoons and comic books to explain biology to anyone that will read them. "Student performance ratings in science in secondary education is dropping at an alarming rate, so clearly something isn't working well in the classroom," he said. "We can't be afraid to try something radical to change how students learn." He team-taught a college course with a historian at Juniata College, Comics and Culture.

Hosler found that it was a comic that helped fuel anti-science sentiment across the country in churches, schools and state houses. He says that one way scientists can counter is by using comics to tell great scientific stories. "That's what I'm trying to do," he said.

He has done the first systematic assessment of how a science comic book can affect student learning and attitudes about biology.<sup>1</sup> He and his research partner, K.B. Boomer, found that "The comic book played a role in engaging and shaping student attitudes in a positive way," and it was "as effective at conveying information in the three classes in which it was used as the more traditional textbook.... By scaffolding educational material with stories, comics can make use of situational narratives to provide context for material and thus a mechanism for improving student learning."

He is hosting "Sequential SmArt", a conference for creators of comics and graphic books, scholars, librarians and teachers from a range of disciplines who teach using comics, and an audience of educators who work with students from early childhood to the college level. The conference will be held May 18-19, 2012, at Juniata College.

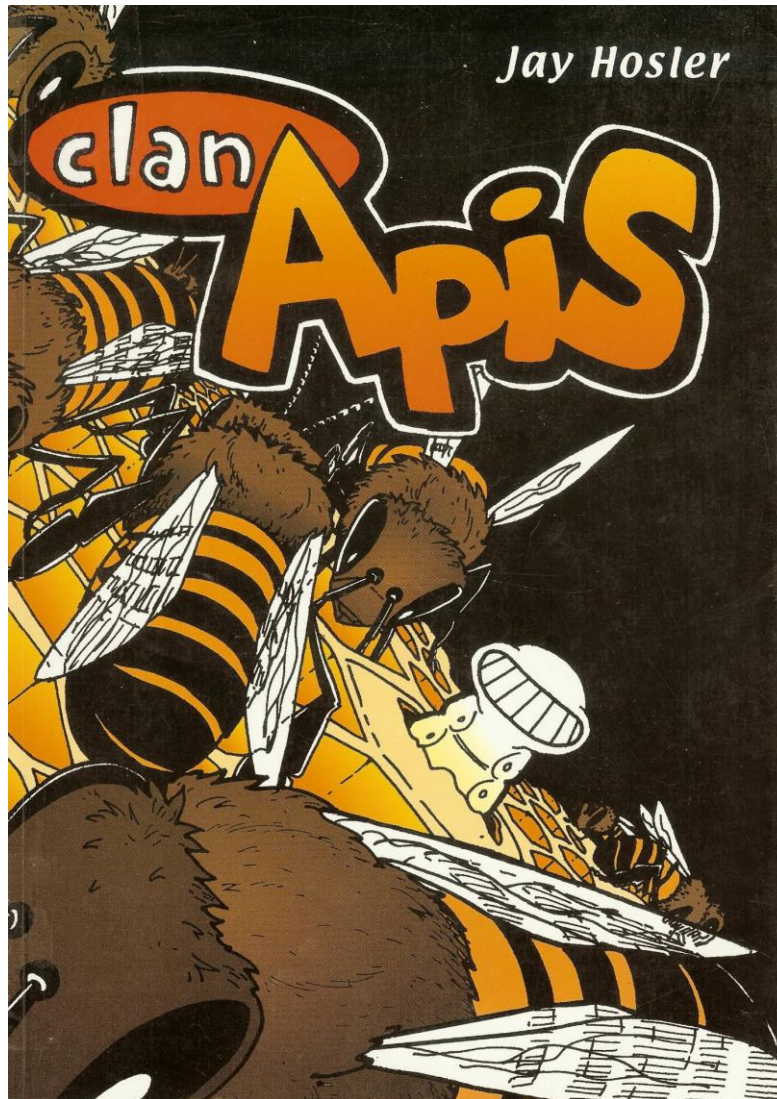
Hosler has started a web resource at <http://comicbooksyllabus.com> that lists comics suitable for teaching the natural sciences, social science, and humanities. His website is [www.jayhoslet.com](http://www.jayhoslet.com), where his books can be ordered and more cartoons can be found.

We can only wonder how the scientific debacle of the \$150 million film “Bee Story” could have been transformed in the hands of Jay Hosler. His story of Nyuki is a beautifully rendered lesson on bees and the natural world – a book well worth the pleasure of reading, giving and using in the classroom.

---

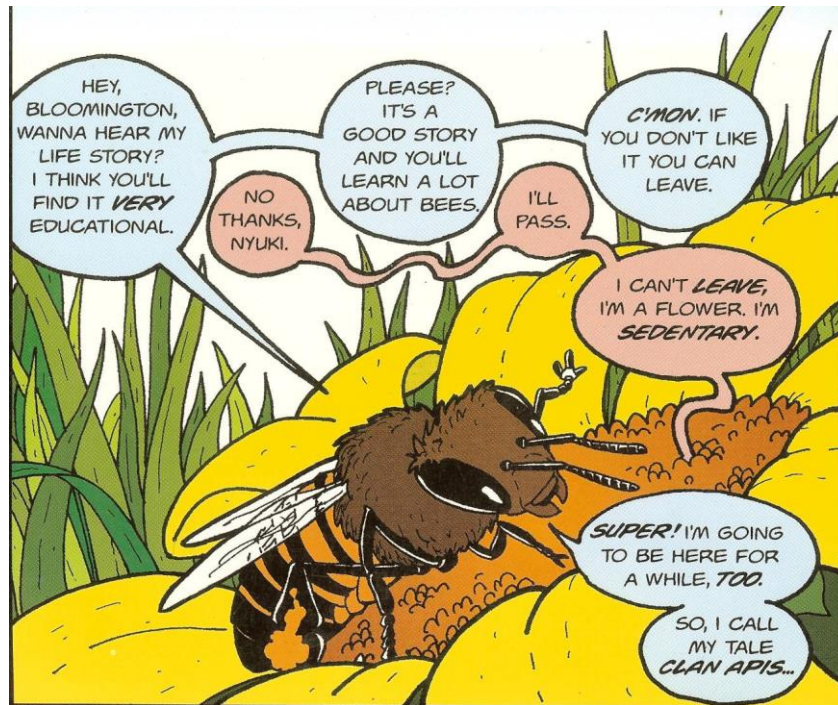
<sup>1</sup> Hosler, Jay and K.B. Boomer, Are comic books an effective way to engage non-majors in learning and appreciating science? .CBE – life-sciences education, volume 10, 309 – 317, fall 2011

*All illustrations and photos, with the exception of those that are attributed, are:  
By permission of Jay Hosler*



*The cover of Clan Apis, a scientific comic book by Jay Hosler that is now in its sixth printing.*

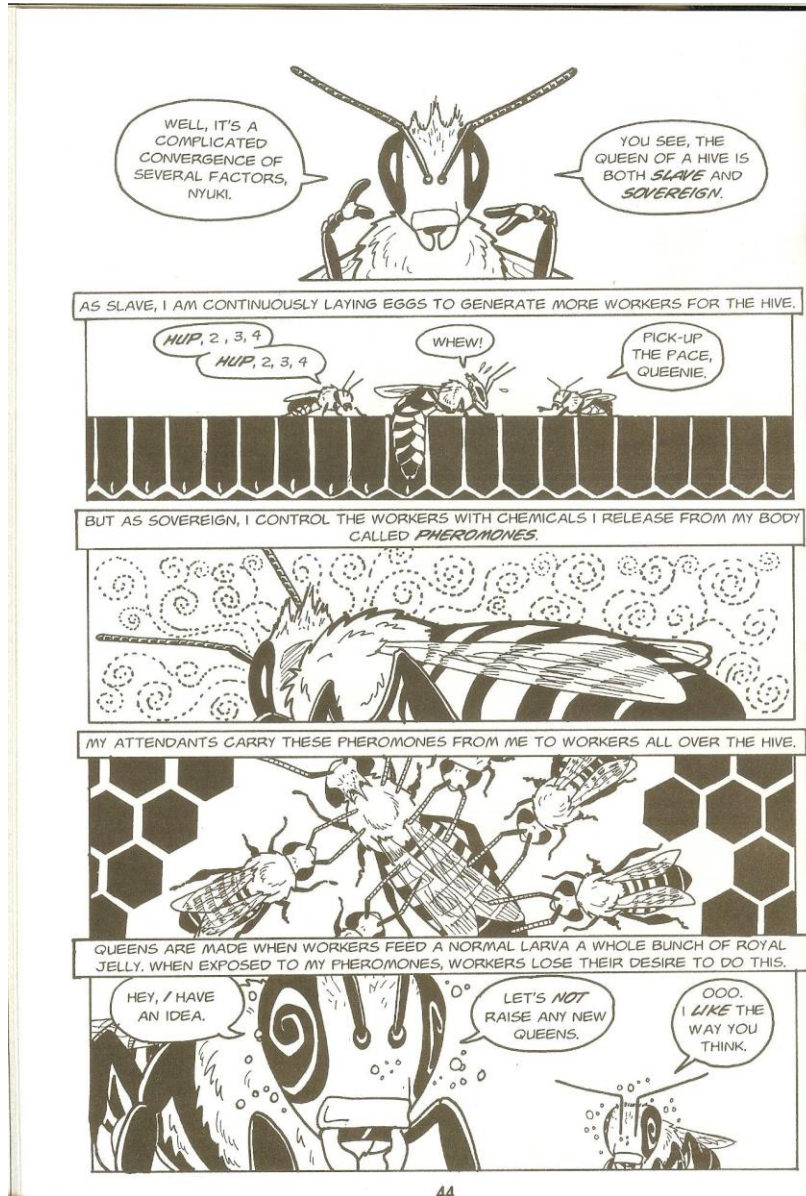




*Hosler's comic tells the story from birth of a worker bee with anatomically accurate drawings of the bees, which are anthropomorphized only in the dialogue.*



*Hosler's sons Jack and Max reading science comics, which their dad's study shows are an effective venue for education. says Hosler, "Jack and I may differ chronologically in age, but mentally we are still fourth graders." Photo by Lisa Hosler*



*Clan Apis* describes the life within the hive, interspersing wisecracking dialogue with scientific narrative. Here, the queen describes her role.





The comic illustrates life within the hive and the interactions of bees with the world outside.

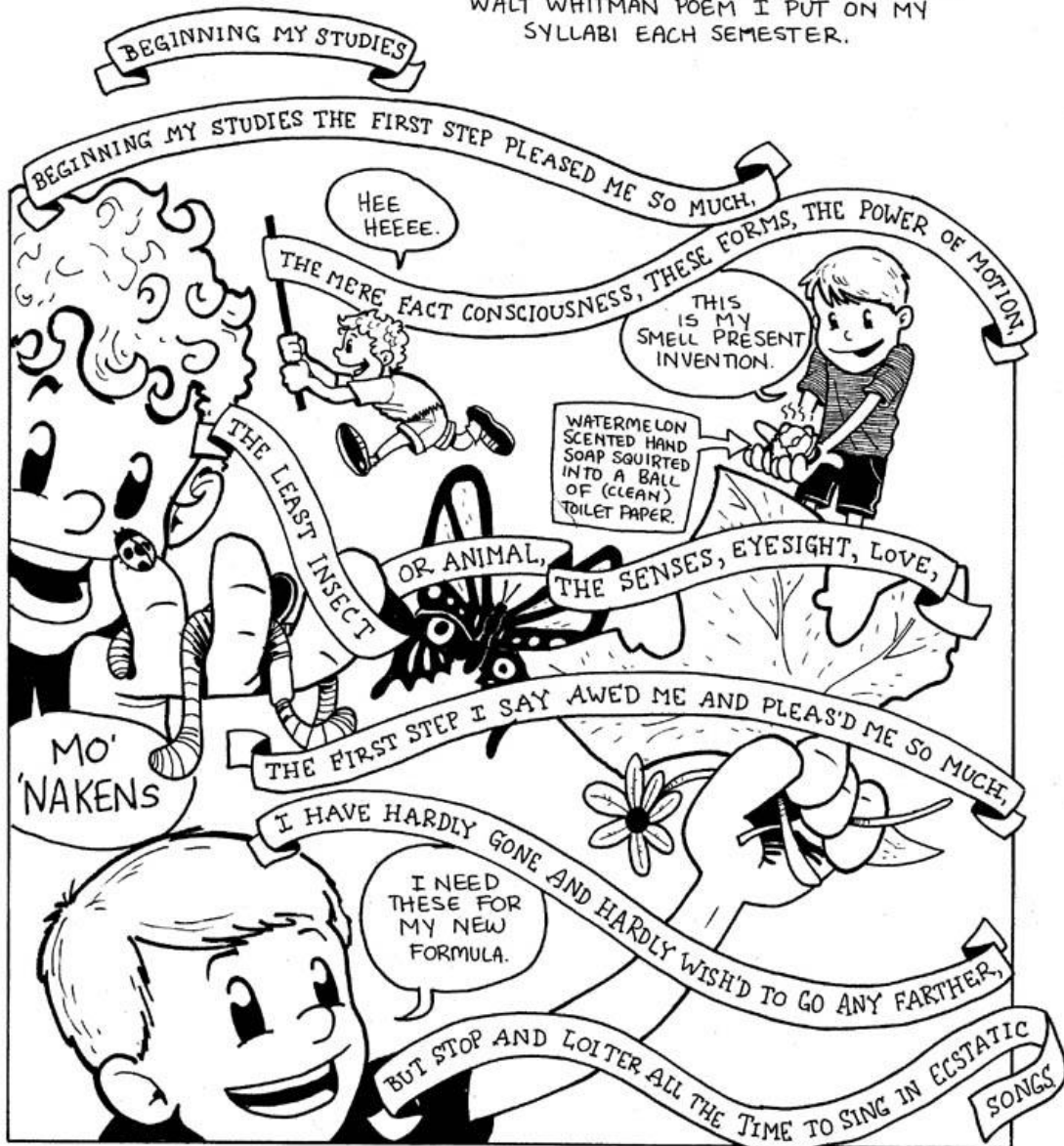




*The story in Clan Apis takes the colony through the cycle of the year, keeping the bees and their activities scientifically accurate.*



LIKE THE BEST SCIENTISTS, KIDS SEE SCIENCE AND PLAY AS THE SAME THING. FORGET THE CONTROLLED EXPERIMENT. KIDS FIND JOY AND DISCOVERY IN THE OUT-OF-CONTROL EXPERIMENT. IN FACT, MY BOYS ARE LIVING THE WALT WHITMAN POEM I PUT ON MY SYLLABI EACH SEMESTER.



MY SONS HAVE REMINDED ME OF THE WONDERS THAT DREW ME TO SCIENCE.

*Hosler's expansive enthusiasm invigorates all of his work. ("Nakens" are snakes, which means worms.)*



*Creature collecting started young with Jay Hosler's sons Jack and Max.  
Photo by Lisa Hosler*



Cartoonist/researcher Jay Hosler with students in the lab at Juniata College, where he makes concepts of biology clear with his scientific comic books. Photo by Jason Jones