DAILYGOOD
News that Inspires

A University Art and Science Fusion Program
by Richard Whittaker

I remember hearing about Donna Billick from John Toki some years ago. John is generous in spreading the word about artists who impress him. Thinking for oneself, passionate commitment, resourcefulness and actually getting things done would rank high among the qualities he values. John's glowing description stuck in my mind.

So when a few months ago, at an open house at Toki's Leslie Ceramics in Berkeley, I happened to meet Billick, I was already primed. She was arranging a display of handmade ceramic honeybees. I asked her what were they all about and in no time we were in a lively conversation. The honeybees, I learned, were ambassadors for the U. C. Davis' Art & Science Fusion program. Billick, it turns out, is the co-founder with entomologist Dr. Diane Ullman. The honeybee decline is a major concern of theirs, but focusing on that is just part of their innovative pedagogy. For the last sixteen years UCD's Art/Science Fusion experiment has been showing, more and more clearly, the benefits of bringing art and science together in a shared approach to learning. Billick likes to say that their curriculum takes students and teachers into the borderland, the uncharted territory between isolated disciplines. It turns out that this borderland is rich in unexpected nutrients for growing new insights and understandings. The program is putting into practice what Joseph Beuys envisioned over thirty years ago: "Creativity isn't the monopoly of artists, this is the crucial fact I've come to realize, and this broader concept of creativity is my concept of art. When I say everybody is an artist, I mean everybody can determine the context of life in his particular sphere, whether in painting, music, engineering, caring for the sick, the economy or whatever. All around us the fundamentals of life are crying out to be shaped or created. But our idea of culture is severely restricted because we've always applied it to art. The dilemma of museums and other cultural institutions stems from the fact that culture is such an isolated field, and that art is even more isolated; an ivory tower in the field of culture surrounded first by the whole complex of culture and education, and then by the media which are also part of culture. We have a restricted idea of culture, which debases everything; and it is the debased concept of art that has forced museums into their present weak and isolated position. Our concept of art must be universal and have the interdisciplinary nature of a university, and there must be a university department with a new concept of art and science."

At UC Davis, such a department actually exists.

Richard Whittaker: You were born in Ohio, came out to Southern California, and then you came up to UC Davis where you got a bachelor's degree in genetics, right?

Donna Billick: Yes. And a master's in art.

RW: So you got your degree in genetics, because you wanted to know…

Donna: The truth of who we are, like the biological facts. And I thought about the DNA, the cells, things that are transmitted through time.

RW: Then hadn't really planned on getting into ceramics. You got vacuumed into that, you said

Donna: Yes. Actually in high school there was an amazing ceramic instructor who took special interest in me, Ed Branston. He said, "You're the best. It's like your hands have little eyeballs at the ends of the fingers."

RW: Did you feel that yourself?

Donna: I did. I felt like a maker. My father was a test pilot, but he also built five or six houses. He just would go to the planning department with his own drawings.

And he built houses out of every material. I came from a family of five. It was a great place to connect with my dad when he was making things. I learned how to enjoy rocks and building materials along side my favorite guy. I was really happy rock stacking.

RW: So you joined in the making?

Donna: Yeah. Lots of rock art. So when I came up to UC Davis, I crossed the path of TB-9, the ceramic studios, this fire pit. And I was really influenced by that group of people. It felt like I had found my peeps.

RW: Let's review who the faculty were at that time.

Donna: It was Roy De Forest, Wayne Thiebaud, Manuel Neri, Bob Arneson, Bill Wiley. Can you believe stumbling into that, Richard? You would have to have a bag over your head to not respond, right?

RW: Right. That was an amazing group!

Donna: So I didn't have a bag on my head. I just completely responded to the sharing, the communicating, the exchange, the ceramics.

RW: There was a good spirit in the department, a cooperative feeling?

Donna: Oh, God! Absolutely! This was a community. And it was building things. Tom Rippon was there at the same time. David Gilhooly was there. Bob was very selective about picking every single student. It's like if you're going to waste my time, get the frick out of here. So it really raised the bar.

RW: So you had your B.A. and then you went in there as a graduate student?

Donna: I actually went there all through my under-graduate years. It was like my sanctuary. And I felt more akin to the people. The thing that happened at TB-9 was that I shifted from an interest in the physical to the cultural truth of who we are. So that rock art—it's like I'm like a 20th century cavewoman. I'm just sort of a savage roaming about, wanting to write and draw on the cave wall—even though I have a lot of education. So when I put my hands on the clay, I realized that the truth about who we were was being transmitted through rock art and clay, and it's the one medium that doesn't degrade.

You look at the mosaics from Greece and China, Italy, all over the world. They're pristine. They look like the day that they were made. And they told the issues. Who are we? What was important to us? All the Neolithic Goddesses, all the little Buddhas and Guanyins and Hanamans; those were the heroines and heros.

Seeing Bob Arneson bring contemporary figuration in using clay—that stepped it up. Bob had the courage to express his ideas and distain for unjust rules with the figure. That made an impression. And I took Jose Arguelles' class. He brought awareness of environmental concerns for the earth, and our taking resources at great cost to our wellbeing. The Whole Earth Festival was created by activist art students. It was quite exciting to be involved what felt like making a difference.

RW: When you say why the Whole Earth Festival was here, do you mean here in Davis?

Donna: Yes. The Whole Earth Festival was, in Jose Arguelles' view, the shove-off to a new way of translating time, space, form, all the things that are fundamental to artists finding their voices. He did performances. One quarter in his class we had to put on a festival that had things we felt were important to be out there. And to open it up to the community, open it up to the campus. Well now, it's a three-day, huge festival that happens every year.

RW: Arguelles started the Whole Earth Festival? [yes] And it was because it expressed his vision of what should be happening in terms of the community and art?

Donna: He felt that time and money were the negative influences on our values. He was an art historian, quintessential; and he was an excellent lecturer. But he wanted to have an action. He wanted to have something really contemporary for students to participate in. So he did this kind of community-build; and that was the Whole Earth Festival. It's continued every year. People come from all over. There's everything that you would like in celebration of the earth: dancing, singing, vendors, craftsmen, artists. So there were roots making connections in me, politically—alternative ways of looking and feeling and thinking about community. And because I came from a big family—the TB-9, really—I felt really natural there.

You know, Bill Wiley would have a conversation. And Gilhooly would come in and share his doughnuts. Bob Arneson would be Bob Arneson. So I was lured to what I think, and I have no regrets, was my true voice. The other thing that happened was Jerry Brown, governor of California, brought in money for the arts making art available to the widest segment of the population; those things truly resonated with me. I wanted to make art that was out where people live and circulate.

RW: This idea of art being more widely open seems right, as opposed to an exclusive club of folks indulging in some kind of mumbo jumbo.

Donna: That's why we are completely attracted to one another; we are like-minded in this.

RW: Earlier you mentioned heroines and heros. When we talk about a hero, we're talking about a person who has achieved some kind of greater potentiality. Would you agree with that?

Donna: Oh, absolutely, absolutely.

RW: And an artwork somehow can be a kind of representative of that possibility?

Donna: That's a restating of my philosophy and why I'm very interested in transmitting these iconic things—like Joseph Campbell? He translates our connectedness to one another through time and who we are and what we've found to be valuable and important.

So I really appreciate that kind of a conversation and I resonated with it. Being in TB-9, there was a very strong figurative tradition that fit right in with my notion of large scale figurative work. I've found the figure and nature to be enduring inspirations.

A personal favorite is Paul Klee. He takes nature and translates it into a fusion of the bigger picture. And taking art history classes, I found Jose Arguelles, who was a contemporary hero, in my opinion. It wasn't common at that point to be concerned about the environment.

RW: So the Whole Earth Festival must have gotten started about the same time Earth Day began in 1970.

Donna: Yes. 1969. A lot of loose wires were getting connected. And there was this magnetism of values and influences. Where I took a stand was in art-making. I felt that was how I could contact the widest number of people. When Jerry Brown voted that 2% for the arts, I couldn't understand why artists were still trying to get into galleries. I didn't want to suck up to a gallery owner. So I decided on large-scale public art and I made a lot of trips to Europe. I wanted to learn how to use ceramic and mosaic in ways so I could translate contemporary life the same way I'd seen history unfold. And that worked out to be a very valuable direction for me to take.

RW: So you decided to work outside of the gallery system.

Donna: Right. I think it was because I was trained as a scientist to be very empirical, to observe and record in my own being, and come up with evidence for what would be my personal journey.

At that time there were really no art facilitators. Art was supposed to be included in this new library and this new light rail station. But nobody knew how to do it. So I was a pirate on board, literally. I was being asked, how do you do this? I said, "Well, you're going to have a design, a fabrication, an installation." —like I knew what I was talking about. But I knew, when I made things, that's how they came together. So they were very supportive, all the art administrators. Because Jerry Brown said, "Get on board little children. We're going to have more public art."

RW: And so this is a piece right here. [we're standing in front of Nature's Gallery Court.] Is it yours?

Donna: My students, yeah. I'm 60 and I wanted to do the hand-off. I was very interested in education, a different approach, an experiential, hands on approach, across disciplines. What I wanted to do was break open the little silos of education where scientists never see artists. Then I met Diane Ullman. She came into the studio and started to make some bugs out of clay.

I said, "Wow, these are really terrific. You know what you're looking at."

You look back at Charles Darwin, the people who changed the way that we see evolution, and they did it by doing little drawings. The art-scientists are the amazing creative people who I admire.

RW: He looked. He used his seeing.

Donna: He looked. Visual thinking and creative confidence.. So Diane and I feel like the students need to break across what E.O. Wilson calls "the borderland." He wrote a book called Consilience that changed my life when I was a scientist. Consilience is the unity of knowledge. Leonardo da Vinci was an art-scientist. You know?

It really comes through strong for me to have visual thinking and a creative way of

solving some of the environmental problems, because these are dire problems. For example, we've been working with the honeybee for three years. Our Art/Science Fusion program is committed to environmental literacy, creativity, collaboration and art making.

RW: Something we pay very little honor to in this culture is the importance of hands-on experience and what comes to us through touching and making. We still have these bodies. And short shrift is given to…

Donna: The senses.

RW: The senses.

Donna: So that's exactly it, Richard!

RW: Do you find there's a hunger for that connection among students?

Donna: Oh, the students love it! They love it! We can't accommodate the number of students that want this class. The students come out here to the Arboretum and become tree-huggers. The Art/Science Fusion has a stake right here on this piece [Nature's Gallery Court]. It's a good example of a community-built project. It's like the Quakers. "Let's get everybody and put this barn up and badaboom."

I think it's really important to be connected to one another in these ways. I'm not interested in making a pretty thing for someone to buy at a high price. I care about well-made things that come from a spirited research into life. The bees have really infected me with their mission and their job.

RW: Okay. Your interest is in something that feels real and has some essential importance.

Donna: I really am, and on a daily basis. I want it to mean something.

RW: In some larger sense?

Donna: Yes. Community. I feel it's essential for us to have a sense of community, because politics is all over the place. We're beating people up all over the planet. And when people can just be with each other at the community level, I think we can find our way. You don't have to carry a gun here.

RW: You can move towards connection.

Donna: Light. You move towards the light. Light is so important. There is nothing but darkness until there is light. And then everything takes form. Everything takes shape in the context of light. I think that inside of us the senses are the beams of light— feeling, seeing, touching, hearing. Those are the fundamental spaces where Diane and I, for the last 16 years, have brought students.

So we take them, for instance, to the UC Davis Ruth Storer Garden and talk about drought tolerant plants. We're here in this Mediterranean space. What about drought tolerant plants? So we have an entomologist, a botanist, a horticulturist. We have artists and musicians, photographers come in and talk to the students about what they're seeing. Looking at the students, the whole campus is represented. [Pointing to a large ceramic mural] That was made by an engineer; that one by a mathematician; this one by a musician.

So you can see this is a real mix. And the students become each other's resource. Together we can find the whole picture. This is the unity of knowledge we're talking about.

RW: That's beautiful.

Donna: Then we have two hours a week of lecture. We also have four hours in what we call the "labudio." It's a name that I made up from lab and studio: labudio.

RW: It's exciting just to hear about this. And what you're doing resonates with your students, I take it.

Donna: Oh, yes it does, it does. They feel safe there, because everybody is on an equal playing field. When you bring things in through your senses, you don't have any cutting edge more than the person sitting next to you. I don't care how many Ph.D.'s you have, this is the truth about that.

RW: And what you're demonstrating is that there's a place for creativity, which is not the private property of a group of people called artists.

Donna: No, no. Creativity is really important. My folks didn't put fences around me. The one thing my dad kept saying ad nauseam was, "Think for yourself. Think for yourself. You've got what it takes. Think for yourself."

RW: I'm struck by your decision to opt out of the gallery system and reach more directly into the world.

Donna: And I'm really committed to that. We need this to be opened, because you go to galleries and there are the same people.

RW: The art world, in that sense, is kind of small.

Donna: It's too small. And, as my mother used to say, "Bring me a bigger problem than finding two socks that match."

RW: Nice!

Donna: Yeah. So the U.S. Botanic Garden wanted to showcase programs that reflected the natural environment and plants and created artifacts. They told us that they had a wall for us if we wanted to take our students and create an Art/Science Fusion piece. They told us they would show it for nine months [Nature's Gallery Court].

RW: How did that travel? I mean, it must weigh…

Donna: These are separate panels. One of my strengths is to format for students who have no experience whatsoever in artmaking. When Diane and I put the Art and Science Fusion program together, we didn't want to be in the art department. And I didn't want to be beholden to any particular science. David Rizzo, Director of the UC Davis Science and Society Program said, "I think it's a great idea. I will house you."

So, we're in SAS, which is a program in the College of Agriculture and Environmental Sciences, the oldest college at UC Davis. We started out at the Harry Laidlaw Honeybee Research site, next to the Haagen-Dasz Honeybee Haven garden. In 1996, Rob Page, the chair of Entomology said, "Here's a room in the research facility. You can try this." We

found that students had a tremendous affinity for it—and these are students from every discipline on campus.

RW: So each panel here in Nature's Gallery was done by a separate student?

Donna: Right. Each student went out into this garden over here, the Ruth Storer drought tolerant garden. We had them learn about drought tolerant plants and the insects that connect with them. Then we asked them to pick a plant based on something they liked, the way it smelled or looked or something that lit their senses up. Then we had them draw it, a full-sized drawing. Then we met with a botanist for a critique, "It doesn't really have leaves like that. They're more like that." So we got the drawings to be accurate. Then Diane and I showed them how to roll out a big slab of clay from the valley and carve it. It's Gladding McBean's clay up there in Lincoln. So it's like farming local produce.

Actually, the first thing we had them do was an insect, because we wanted them to get a feel for what the glazes looked like and to get their hands on the carving tools to see what they could do. And when they pulled them out of the kiln, they could show each other. "Oh. How did you get that color?" Or, "What tool did you use for that?" So then they started sharing.

One of the things that's different about the labudio is we're asking the students to collaborate. And they knew this project was going to the US Botanic Garden site on the National Mall right next to the Capitol. I said, "You could try to get to a National Mall site all your life." Some of the students were like, "I've got a rash all over my body. This is making me nervous!" And I said, "So you're going to do great, because that's a good response."

Another thing we do is that one night a week we open the labudio up to the community—to people who just want to come and assist in these projects. Because we had 38 students and 76 panels to make.

RW: That's beautiful.

Donna: I want to emphasize that community-build is one of the things that passes through all of my work. This is the place of empowerment where ownership happens and the students get a feel; they leave the campus in four years; they put in a ton of money and energy, and this is something they can come back to all their lives and their kids' lives.

This project took just one quarter, and the program has been here now for 16 years. So you can imagine. There are all kinds of connections. We have a photography class and the professor is an atmospheric scientist, Terry Nathan. He came to us and said, "I've been a bit of a photographer all my life, and I'm an atmospheric scientist. There was never room for it."

I said, "There's room here! You're from the borderland. Come on in!" He teaches every spring quarter, and it's packed. He starts off by talking about light and the lens and how all that evolved through time. He talks about shape and form. He has them stack blocks and then he has them come up with some art-science theory that they create a photograph to describe. Another professor, Wendy Silk teaches environmental science with music. It's an amazing program. Every one of the instructors has a different approach to what they think art-science is. I like those situations. It's kind of like with the public art where you're a pirate on board. There aren't all these rules on how it ought to go.

RW: Right. How many teachers are in the Art-Science Fusion program?

Donna: There are four of us and then there are a lot of students we've mentored. We have graduate students that teach, too.

RW: Now Diane is one of the teachers, right?

Donna: She's an entomologist. Dr. Ullman and I are the co-founders of the program. We made this up. I said it's always been in my wish queue to have an Art/Science Fusion approach. When the two of us conceived of the idea, she took it to the Department of Entomology and they said, "Well, not too many people are signing up to be bug people. So give it a shot." And now 16 years later, the labudio exists and these major murals and installations all over the UC Davis campus. Just like Antonio Gaudi, I wanted to land someplace and just put out a bomb-load of art—and without waiting for commissions. I just wanted to do it! And I wanted to make a difference in where the students found their creative voice.

RW: There must be some gratifying moments when non-art students are doing creative work.

Donna: Yes, absolutely. It's really powerful. I mean it's kept me running the gauntlet for 16 years.

RW: You have a place in Baja, in Todos Santos. You do projects where you invite people down, but you also work with the people that are there.

Donna: Correct. I think art is a communication sport. I just send a car around inviting the Mexicans in town to come and have a hand in making the mural. And they come out of the woodwork.

RW: [Donna's friend from Todos Santos joins us] Elro, you were nodding your head. So Donna's project makes connections between different cultural groups?

Elro: Oh, absolutely. After school, groups of high school kids come. Workmen will come two, three, four at a time and stay for hours. Families come together and add new pieces. Everybody gets to make something and put it there. The whole community is so happy and so proud of the pieces they did.

Elro: There will never be any graffiti. There will never be any vandalism.

Donna: So that's a fusion across culture. Here, the Art/Science Fusion Program is cross-disciplinary.

RW: And earlier you called yourself a "fusionist."

Donna: Because I think the whole opening up of the circle, Richard, is going to take some fusion. We have a consilience exhibit at the Pence Gallery in Davis every year. The director said, "We've never had 800 people walk in the door on an opening before."

RW: [Dr. Diane Ullman arrives] I'm thrilled to be hearing about the fusion program. And you're a professor here?

Diane Ullman: Right. I'm a faculty member in the Department of Entomology, which is the study of insect science.

RW: Which I'm guessing is a big thing here at UC Davis with so much focus on agriculture.

Diane: Right. And I'm also the associate dean for undergraduate academic programs in the College of Agricultural and Environmental Sciences. We have 15 departments that cover everything from animal science, plant science to managerial economics. And I have a research laboratory that I run. But I've always loved undergraduate education. So when I came to UC Davis in 1995, I got really excited about contributing to undergraduate classes. And you know, they just assign classes to you when you're a new faculty member here. And I kept getting these classes that had 200, 250 students.

They gave me a class called "Insects and Human Affairs." It was supposed to be about the importance of insects to people. Somebody had been doing it for 12 or 13 years and it had gotten boring even though the topic was really exciting. I thought, we're supposed to be getting them excited about these incredible animals that are everywhere and are so important! Yet I was hooked into the stand-and-lecture strategy. And after a year of that, I thought I've got to find a better way. And by good fortune, I met Donna. I took a ceramics sculpture class from her and that connection grew into the UC Davis Art/Science Fusion Program.

RW: Now what inspired you to take a ceramics sculpture class?

Diane: This is very interesting, really. There was a professor, Sean Duffey, in the Department of Entomology here who played an instrumental role in my education when I was a graduate student. So I get back here. I start teaching, and I'm disillusioned, as I was telling you. Literally in the height of that disillusionment, Sean, a very important mentor to me, who was only 52 years old, walks out off the elevator and drops dead in the hallway. And he was one of those people who just glued the whole department together. There wasn't a person who didn't love him. The department was in a state of collective hysteria and grief. My daughter, Sophie, who was eight years old at the time, had just done a mosaic in her elementary school with Donna. And she says, with her old soul wisdom, "Mom, you need to do a memorial. And I know just the person to do it. Her name is Donna Billick."

Now I didn't know Donna. So I went to Ann Duffey, Sean's widow, and asked if she thought it was a good idea. Her immediate response was, "Oh, my God! Sean loved Donna's work!"

So Ann, several faculty and students went out to Donna's studio and had this big session where we talked about who Sean was and what he meant to people. By the end of that, Donna had a maquette for a piece of memorial art for Sean, to be engraved into granite. I became the liaison for the department. So it was my job to go to the studio and check in with Donna along the way. When she was in the final stages of getting things ready to sandblast, I said, "Wow, girlfriend, you have got this so dialed! I mean you've got the greatest job I've ever seen anybody have!"

Donna smiled and said, "Oh yeah? You think it's easy? Well, let's see if you have what it takes." She said, "I'm teaching a class this summer." I felt like I needed something for my teaching and I thought that's the perfect thing!

On the first day of class, Donna announced to the class, "Your final project will be a life-sized, self-portrait." She was joking, but I'm not really good at detecting jokes. I thought, boy, I might be in over my head here, but I'm going for it. So all quarter long I kept looking around and wondering, when is everybody else going to start their life-size piece?

Donna: She did the self-portrait. I mean, she just blew my mind.

RW: That's hilarious.

Diane: Finally Donna comes over and says, “I think I see where you’re going with this piece.” And by then there was no turning back. The sculpture is in my garden at home. It was an amazing first experience with clay and reaching inside myself. I was hooked.

Donna: Diane does not have an off-button.

Diane: I’d dabbled in arts and crafts when I was younger. Then in high school, I was shuffled into the sciences. Then there was no more art.

Donna: That’s what happens in our system. So Diane was ready for that borderland—that fusion, too..

Diane: After that, Donna invited me to work on some of her public art projects.

Donna: She made insects having sex on art murals.

Diane: Donna invited me to help with insects for a 4,000 square foot ceramic mosaic mural in Sacramento. I asked, “Is it okay if I do these mating insects?” She said, “Sure, go ahead.” And while we were doing that work, I realized how powerful that learning tool is when you learn something, and then you create it with your hands. Because even as an entomologist, while I was building the insects, I had to keep going back and checking for accuracy, “Oh yeah, that’s where the leg actually hooks on, that’s how they hold their wings.”

RW: So you saw firsthand there what a great learning tool that is.

Diane: Exactly, because this was a male cricket mating with a female cricket. Before, I could tell you the general characteristics of the cricket. But right now, if you said make those crickets, I could make them perfectly. And it’s been years ago. So very late one night in Donna’s studio, I had this epiphany that we could teach students to love entomology and understand insects by having them build sculptures out of clay, draw them, paint or create textiles—and I talked with Donna about the idea.

She said, “I would love to participate in trying to do that kind of innovation.” So we totally came to this together as a team around how we would teach basic entomology. We wanted to do it as a general education course, which anybody could take. I wanted to get the science kids to do art, and Donna wanted to get the art kids to do science.

RW: Why did you want the science kids to do art?

Diane: I could see the intensity of creativity that it stimulated. Science is a very creative endeavor, but we don’t give our science students a chance to think creatively because we're so busy having them memorize facts. A kind of catalytic reaction happens when you bring art and science together—a whole new way of thinking, learning and engaging rises up.

One of the issues we face in the sciences is retention of students in what we call the STEM fields—that’s science, technology, engineering and math. They come in droves to these disciplines and they leave in droves. Students who come to UC Davis have usually been highly successful in high school. So why do we lose them to STEM education?

Donna: It’s boring. Have you ever been in a science lecture and it’s just one chart and stuff after another.

Diane: Without ever being brought to life, or wrapped around reality.

Donna: Yeah, it needs to be brought to life.

Diane: I was personally interested in recruiting students to the insect world who thought they might be interested in science, because there aren't all that many of us. I think there are maybe 3,000 entomologists on the planet, yet insects are the most abundant animals on the planet and major competitors for our food and shelter.

Donna: Yeah. If you look at the pie chart of life, insects are two-thirds of it. Then there are the humans and the plants.

RW: Wait a minute. Two-thirds? By what measure?

Diane: By the number of species, by the number of individuals, by the number of environments that they live in, and by their sheer weight. For example, experts like E. O. Wilson estimate that ants account for maybe a quarter of all terrestrial animal biomass. This is roughly the percentage of biomass claimed by humans on the planet. And that's just one family of insect.

RW: That's unbelievable, isn't it?

Donna: When I was sitting in lectures—and I wouldn't miss them—it was like, are you kidding me?

Diane: So that's why I wanted to attract the scientists and give them an outlet to stimulate creativity, because science is a very creative process.

I take a lot of undergraduate students into my program. I see that science students get out of their bachelor's program and they can recite the tree of life. They can tell you what DNA is, what RNA is. They can tell you what they learned in books, but they don't really know how to do anything. And they don't know how to think for themselves.

I also have graduate students that I mentor. One of the first things we have to do in graduate school is get them started understanding that we're not going to tell them what to do; they have to read and learn what others have done within their area of interest, then they have to come up with an original question. So imagine that your life depends on coming up with an original question and you've never thought for yourself before.

Kids get turned off to art early on and the same thing happens in the sciences. Students form the humanities often come to us and say, "I'm not smart enough to understand science."

These are the citizens of our world and we're asking them to make decisions about problems like climate change! Why do you think half the people in the nation don't believe in climate change? It's because they're not science literate.

A huge part of the Art/Science Fusion Program is to make everyone visually and scientifically literate. When you layer in the creativity we bring out in students one becomes hopeful about the planet's future. No question, the survival of the planet is in the hands of our young people and education is the key to innovation and solutions.

RW: This is serious stuff you're talking about.

Diane: It is. When Donna and I decided to teach an entomology class in the art/science fusion paradigm, the first obstacle was getting a course approved. The approval process for a class is a big deal on the UC Davis campus. It typically takes two years. I was ready for that, and I proposed the class. I asked for it to be classified as general education. I expected someone to question a class meeting both science and art criteria. I fully

expected it to be rejected. It was approved in six weeks.

Donna: That's right. It's time for this.

Diane: We've always had a full class with a wait list. Sometimes we offer it to 75 students. Sometimes we offer it to 130 students. It doesn't matter how big the offering is. It fills and there's a wait list.

Donna: Diane was interested in sprinkling the education with that creativity, because that's the part where you can go ahead and reach outside the box.

Diane: And our teaching strategy gives the students the ability to care—you can see that. So I'll walk you through and you'll see some of our projects.

RW: One quick question here. I'm so interested in talking to a scientist and having creativity and feeling be a big part of it. I think a lot of kids interested in science start out with wonder and passion. Does that tend to get weeded out in the process?

Diane: It does for some. It's fascinating. I've seen a lot of change in the young people coming to the University, because I've been here for 19 years. A lot of students coming into the sciences now, their families want them to be doctors, engineers or chemists. They've been pushed hard. So they know a lot. And they're pretty good at questioning things, which is nice, because that's new. Ten years ago students were good at memorizing things, but they couldn't tell you what they meant. During the last two years, I have seen a shift in the student willingness to reach deeper.

RW: That's a new thing, you say?

Diane: It's fairly new. But they've been so focused, they haven't experienced the world. I have four interns in my lab this summer. One of them is a young woman I met through the Art-Science Fusion program. She's so creative and so passionate; she tells me that her problem is that she's passionate about everything." I I tell her, "I know your pain."

Donna: She's a doer, a maker.

Diane: She went to a national professional meeting to present her first scientific poster last Fall. She was pretty nervous. She came to Donna and me and said, "I want my poster to be the one that everybody is talking about."

She was working with bark beetles, little beetles that bore into trees and ultimately kill them. So the center of her poster was the trunk of the tree, a really sharp close-up of the bark. Then she built just the thorax and the front legs and the head of the bark beetle coming out of the trunk with clay. The finished sculpture sticks out probably 8 inches, a totally 3D sculpture in beautiful, spectacular detail—even the little scales on the exoskeleton and the antennae, everything. It was a huge success at the meeting and it was in the local newspapers. It currently hangs in the entomology department's hallway.

Donna: We were just throwing logs on that fire.

Diane: On the other hand, students hold themselves to a standard of perfection that leaves them with no room to think for themselves or create. I have another student and his family wants him to be a doctor. He came to me terribly upset and said, "Dr. Ullman, I totally messed up!"

I said, "I think you're doing great."

He says, “No. I got an “A minus. I have a 3.9 now.”

This young man cannot do the simplest things. He can think really well. He knows book learning, but doesn’t know how to do things with his hands and he thinks the work he does with his hands is beneath him. He keeps asking, “When are you going to give me something important to do?”

I have to say, “You know what? When we do an experiment and it has twenty-five steps, every step is important. If step number one happens to be putting the alcohol in the vials and labeling them properly, if that’s not done right, we get to step number 25 and it’s all for naught.” I’ve had to struggle with him. Finally I came to the understanding that he’s never had to actually bring a hands-on project to completion.

The Art/Science Fusion Program is a fantastic experience for students like this, and also for those who already have appreciation for experiential learning. We connect all of the dots for the students. They have to come up with a creative idea of their own. They have to research it. They have to design it. They have to fabricate it. We involve them as much as possible in the installation. And they’ve got to stand up and talk about what they did. And along the way they learn to work in a team and to collaborate.

RW: Well that’s wonderful.

Diane: [we walk to a new place] This is the Shields Oak Grove. It has the largest collection of oak species in the United States so it’s actually a living museum. It was started by a professor named John Tucker. At that time, 65 years ago, it was okay if you brought acorns back in your suitcase. So he would study oaks in different parts of the world and bring back the acorns. And he happened to be the director of the arboretum here. So these magnificent trees grew, every one of them, from his acorns. It’s a very important research collection.

We brought the students out here and identified 29 species of oaks that represented the primary branches of the evolutionary tree for oak species. The students had to find the tree, experience the tree, collect the leaves and acorns from the tree. And we connected them with the expert who curates this collection, Emily Griswold. She talked with them about the biology of the oaks, how to identify oaks and all the different kinds of animals and the ecology around the oak ecosystem.

With Emily’s guidance, Donna and I drew the branches of the evolutionary tree of the oak on this concrete wall. Each primary branch represents a different section in the phylogeny of the oaks and the secondary branches represent the species in that section. The students knew right where their spot was, like the person who was doing Quercus infectoria would have known, “that’s my spot right here.”
[pointing to a part of the ceramic mural]

RW: So in other words, each leaf here is from a different species of oak?

Diane: Yes. We challenged them to make a portrait of the leaf and the acorn, because those are the primary ways we identify the oak. They had to make sure the acorn was the right size relative to the leaf. Then we challenged them to find an insect that was present on that oak at its origin in the country that it came from. That’s what each of these portraits shows.

Interestingly, there was a young man working out here in the collection who was getting his Ph.D. in evolution and ecology. He was studying these same 29 species of oaks trying to see what local insects had adapted to them. So he got very excited the day we were installing this mural. When his study was accepted to the Proceedings of the National Academy of Sciences, he submitted a photo of this mural as cover artwork. So we were on the cover of the National Academy with this.

RW: Oh, nice!

Diane: The Art/Science Fusion Program has a huge commitment to outreach to K-12 students and to the community. While we built "Oak Family Tree" as this mural is called, we had school kids, 4th through 6th grade, learning about the different kinds of oaks and how their leaves and acorns differed. So a lot of the leaves and acorns you see on here were created by school kids. Our own students actually did the installation. This was actually the first large-scale project we did. Then Nature's Gallery Court was the second piece. [pointing now to another ceramic mural] That side of the building has a depiction of the Ruth Storer Garden. It's a community piece.

RW: When you say a community piece, what do you mean?

Diane: We hold community nights and we invite the entire community to come and work. So we have nursery school kids up to seniors. And everyone in-between. We had a ton of fun and people learned a lot working on these benches at the entry to the oak grove. Emily Griswold, the curator of these oak trees, kept saying it was the perfect place for a living classroom. She started trying to raise funding to build these [cast concrete with tiled tops showing the oak trees, their life cycles and ecology] and after a while she said, "I'm tired of raising funds" and with her husband, she just put her entire savings into building these benches. She helped us develop the topics for each bench and each student did separate research and the depiction of their topic. Like the student who made this [pointing to one of the tiled sections] talked about the fact that Leonardo da Vinci wrote all of his journals using ink made from oak gall.

Donna: We really quickly turned the teaching over to the students.

RW: They do their own research.

Donna: Right. So Diane and I are shedding the teaching and becoming the learners. And we're interested in that collaboration part, because this is obviously a collaboration. Most of education is just competitive. We're trying to deflect that point of view. At the final stretch, it's all a collaboration. The outcome is a group dynamic; it's that community-build.

Diane: We put them in a situation where they're responsible for their pieces. And if they don't do theirs, they know they're letting down the people on either side of them. And because they're presenting to each other, there's an element of pride that comes in. You don't want to be the one who didn't do your research and get up there and look like a fool. You know? So they really take ownership of that. They become the teachers. AND they really care about the work. It's over 16 years that we've been doing this.

RW: That's fantastic. Has this program spawned any others like it?

Donna: This program is unique in it being at the undergraduate level. There are now a few programs that are similar—at MIT, University of Texas, and a few other schools. When we cast a broad net for our speaker series, the Consilience Speaker series, and for the exhibitions…

RW: What does consilience mean?

Donna: Consilience is the unity of knowledge. E.O. Wilson wrote a book called Consilience. It's a term that somebody proposed in the 1800s, but it kind of fell out of the

vernacular. And he brought it back. [to Diane] Did he get a Pulitzer for Consilience?

Diane: He might have. It's really interesting.

Donna: It brings art and science together. And Paul Klee was really, for me, the catalyst for putting art and nature together, which is really fundamental. You can obviously see this is where Diane and I come together. We're suggesting that nature can do the talking, whether it's the bees or whether it's this beautiful canopy of oaks.

RW: What a wealth of material you have here! Science—and what was the STEM?

Donna: Science, technology, engineering and math.

RW: Then when you put "art" in there, you get…

Donna: STEAM! Science, technology, engineering, art and math.

Diane: I wrote a huge grant trying to get a few million dollars to make STEAM for innovation at UC Davis. I had everybody on this campus excited about it, people from art, from design, techno-culture, creative writing. Scientists, too. The new director of the art museum was deeply engaged and the director of the arboretum. But we didn't get it.

RW: [Now at Honeybee Haven] I love this bee sculpture! And you call this a forage garden?

Donna: Yeah, it's a pollinator garden.

RW: So in other words, every plant here is something that the bees love.

Donna: It's something that they love, love, love. So the idea is to make a living classroom again. This garden was funded by Haagen-Dazs.

Diane: That building over there is the Harry Laidlaw Honeybee Research Facility. It's a major research facility for the West Coast.

Donna: When we first got started, Harry's protégé, Rob Page, was the one who sponsored us putting a classroom together in there. He gave us a place to have the labudio.

RW: Were you already officially sanctioned by the university?

Diane: We'd gotten money to teach our first class. We used the craft center on campus. It was a nightmare because it was not space dedicated to our use.

RW: So Honeybee Haven. Are bees particularly interesting to you?

Diane: I can't think of many more fascinating animals. And they're fascinating to anybody who learns about them—especially if they get a chance to open up a hive. After that they're hooked, because the bees are so phenomenal. They do so many interesting things. On the scientific side, they've been used as a model for understanding behavior on all different levels.

RW: How important are bees to us humans?

Diane: Every third bite you take comes from a honeybee pollinating.

Donna: You might wonder, why would an ice cream maker contribute funding? Well alfalfa is a pollinated food. No alfalfa, no cow; no cow, no milk.

Diane: And then, you know, almonds. Almonds are second only to dairy for farm gate value in the State of California. And they're 100 percent reliant on honeybees for pollination.

RW: They're having some problems, aren't they?

Diane: They are, because the honeybees have been dying off. And we don't know the cause. It's likely from the convergence of many different stresses—from parasites to viruses to pesticides to lack of food. One thing that people agree on is that there is not enough food for the bees.

Donna: Forage.

Diane: And a honeybee garden is something you can do any place. Even if you live in a high-rise.

Donna: Like Meredith May demonstrated when we went to the San Francisco Chronicle to look at the hives on the roof! We looked 360 degrees and all we saw were high-rises. Like where do they find the food, the forage?

Diane: When John Muir was hiking across the state of California in the late 1800s it was a solid mass of flowers from the ocean shore to well up past here. He called the Central Valley of California the "bee pastures." And now look; it's all houses and agriculture where we go in and kill everything, and then we plant monocultures. There's a great TED talk by Marla Spivak—"Why the Bees Are Disappearing."

RW: Pesticides.

Diane: And then there are the pesticides. Colony collapse is what this phenomenon of the bees leaving the hive and not returning is called. You have a thriving colony and one day all the worker bees leave. The scientific community has no clear idea why that happens, but one idea is the food issue. But the other is that you can't control where a honeybee goes. They're going to fly three to five miles collecting food. So let's say you're keeping an area organic. The bees are going to fly here, but also there. So what happens when they bring nectar back from plants that were sprayed with a pesticide? The bees take that nectar and they evaporate it to make it into honey. And guess what happens? It concentrates the pesticides.

So scientists have been doing tests on pollen, nectar and honey in the hives. They've found every class of pesticide in hives—as many as 21 pesticides in one sample of pollen. There are lots of pesticides that are not going to kill the bees outright. But they're concentrating it. It's complicated. For example, certain fungicides used in crops have been shown to make bees more susceptible to mite parasites.

RW: nbsp; And I imagine if a bee doesn't die, it may still be disoriented or something. Right?

Diane: It could. Some people think this is what happens when bees get high doses of neonicotinoids. We don't know why they leave and they don't come back. Since I got my

Ph.D. in 1985, there's been one parasite and disease after another coming into honeybees—fungi, bacteria, viruses. And now we're seeing other pollinators, like the bumblebees and other kinds of solitary nesting bees, diminishing.

Donna: So with the Art-Science Fusion, our mission is to introduce bee culture to undergraduates and fifth-graders. The back of these benches were done by reaching out to school children--fifth-graders. I think we need to go into K- 12 classrooms. The idea is to get them supporting the bees with forage and bringing people out to this demonstration garden. We need to work together. You can partner up with artists and musicians and people who can actually get it out to the culture. And a honeybee pollination garden is a great place to showcase art.

RW: How many species of bees show up here?

Diane: Oh gosh. One of our emeritus scientists, Robbin Thorp, has identified 70 or more species that he's collected himself in this garden alone. In the Spring there are just all kinds of bees out here.

RW: Do you find that among the entomology students there's a special concern about the bees?

Diane: There's a lot of interest in the bees. For the graduate program last year, a lot of our applications were for honeybee research. And we've just hired three new faculty over the last three years—just to focus on honeybees. People look to the university to do the research.

RW: Is this problem worldwide?

Donna: It's endemic. It's all over the world.

Diane: It's all over the world. It's spread like a disease. That's the reason why people still think a pathogen is somehow involved in this, because of the way it spread. And people keep finding a new pathogen candidates. Then they can't really link it back to the collapse.

Do you remember when the AIDS crisis started? It was hard to discover the cause. People are looking for something like that, but whatever it is, the disorder has spread. It took years for it to become pandemic.

Donna: The idea here is to just keep throwing a bigger and bigger net out, getting more people involved. The more points of view you have, the more chance you've got of hitting on what it is.

Diane: And every year since we started, Donna and I have recruited at least three to five students to entomology. I'm quite certain that's more than anybody else has recruited.

Donna: It's that hands-on piece that engages them. They're more open. It's like, wow, I get to touch them and get in there. Here they really kind of break rank.

Diane: And the experiential piece is so great that I've started to hate lecturing. I want to get us more time in the labudio.

Donna: Yeah. They love it there.

Diane: Students start out, usually between 20 and 25 in each of our sections in the labudio, and they're not talking to each other. Then we start throwing them into this thing where they have to talk to each other. They have to work together. They have to present their research to each other. By about week four, it's getting livelier. By week six, they're just totally into it.

Donna: Education and art and science are great bedfellows. I'm really committed to opening up to that cross-fertilization. You have to have all the voices at the table. So I would love to see this spread like a virus.

Diane: Just to tag on to that, MIT has a program. It's different than what we do, but still, it's an arts-science connection program. The University of Texas started a program. They've all been started with endowments from major foundations or from a private donor who comes in and says, "Here's two million dollars. Go do this thing." Here at UC Davis, we need to get kick-started like that. It just takes the right person to see this and not be threatened by it. We're ready for STEAM!

It's really STEAM for innovation, STEAM for creativity. It's so valuable. But when we go to funding agencies, they say, "It's a little too artsy. Sorry." Then you go over to another one and they go, "Uh, it's a little too science-y." You know?

Donna: So that's what we're up against.