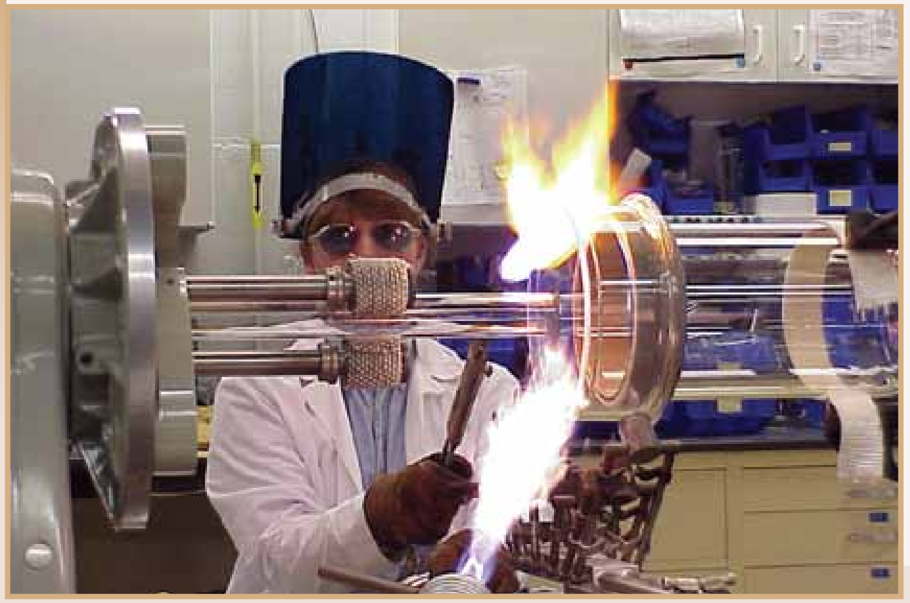
Doni Hatz — Understanding Scientific Glass



Photography by Mark Cheadle

Below are excerpts from a Glasscaster interview featuring scientific glassblower and glass artist, Doni Hatz. Glasscaster podcasts feature "hot glass talk in a high-tech world." This series, hosted by Marcie Davis, can be found at www.fireladyproductions.com or on iTunes.

Doni, thinking back to your time in the Salem Community College scientific glass program, tell me how the course of study for scientific glassblowers differs from artistic glass.

It's completely different. In scientific work, glass is working with tubing and the tubing comes in 49-inch lengths or 59 inches. You cut the tubing into smaller pieces and work it at a stationary torch at the bench. We learned with Carlisles and a Carlisle CC Plus burner, but we also had access to Herbert Arnolds and Bethlehems so that you can understand the different types of torches. It wasn't until the first year at college that I realized your fire is just as much your learning curve—how much fire, what direction of the fire, and where you position the glass in the fire. All of those things are the key to the success of your project. You have to understand how the glass is being used in industry to be a better designer of the glassware in the long run.

The school is actually a two-year baseline of learning the skill sets, but it still takes about five to ten years to see the full spectrum of how the glass is used in research. You have to understand distillation and sublimation and all the different basic chemistry applications plus the designs of it so you actually design the proper piece of glassware that's not going to have restrictions and that won't cause problems with the experiment.

So it's not just standard production from project to project. It's based on what they're trying to research and discover?

Exactly. The whole point of the glass is the visual observation of what's happening with the experiment. The first questions are: Is it gas, liquid, or solid? Is it positive pressure, negative pressure, or atmospheric—that is, open to room temperature? Do you have to use a Teflon stopcock where you don't have to worry about solvents dissolving grease, or can you use a greased stopcock? Do you need to go to a high-vacuum valve? That's what's really fun about learning all the different component parts.

Your connections would have to be really perfect, because if there was a slight hole or gap, it would change the way that the pressurization would take place inside the equipment, and that would throw off everything.

Part of the different projects will require different critical aspects that you have to remember. If it's going to be glassware that's made for something under vacuum, for example, the glassware is going to have negative pressure on it. When I'm done with the glassware, I pull a vacuum on it and spark-test it to see where there might be a leak. That's also very important in doing neon work. You have to evacuate the glassware, then backfill it with the neon or argon or whatever it is. That's just a part of the process.

If you locate a small hole, how do you take care of it?

When you spark-test it and find a leak, usually you can't even see it. It looks like the tiniest little air bubble. You do a little circle around the dot, then you heat the glassware back up in that one spot and pull it out or cap it with a solid rod—just a tiny dot of extra glass, so it keeps it from having that hole to the surface.

The ideal thing is to pull the work out and then put it back in with more clear glass.

What does a scientific glass blower do on a daily basis?

Every scientific glassblowing job is going to be different, since it's always based upon the research that's being done in that company. P&G has 300 different products. It's more prototyping, but we also do some standard chemistry. There were many years when P&G had a pharmaceutical department, so we were doing a lot of organic chemistry. I make it; they break it. I modify it. I repair it. It was a nice cycle. What we do looks just like what would be made out of the catalog, but it's got a different size, height, shape, volume, different ports. We're the customized laboratory glasswork people.

Is standard wall thickness crucial?

It depends on the job. In scientific glass, we almost always work with standard wall thickness. You don't want to have it any thicker than it needs to be because of temperature differential. You don't need the glass to be thick, because then you have to deal with thermal shock issues, depending on if they're heating it, so standard wall is fine. And being round, it can take a vacuum, because usually you don't want to pull a vacuum on a flat surface like a window or anything like that. In the shop where I work and in almost all the shops where I've worked in the last twenty-five years, we stock 2 mm tubing—2 mm OD—up to 180 mm OD, so it's seven inches.

Because all of the connections are so imperative, what do you do for annealing? How do you get the stress out of the glass when it's got so many connections?

We have large ovens. Almost all of us in the standard glass shops will have a large bell jar oven with a lid that has a counterweight. You crank up the lid, and it has all the elements inside. Usually the Wilt ovens that most of us have are about a five- or six-foot bed with a depth of about 20 inches and also about a 20-inch height inside. You can do some pretty big pieces. But I've had some that just barely fit into my oven. I had to prop it up at an angle so I could get the whole piece in there. You have to be careful, because you don't want to put it directly on the elements. The standard rule of thumb is that we anneal our glassware every night, so the oven is run every single night and you fill up the oven.

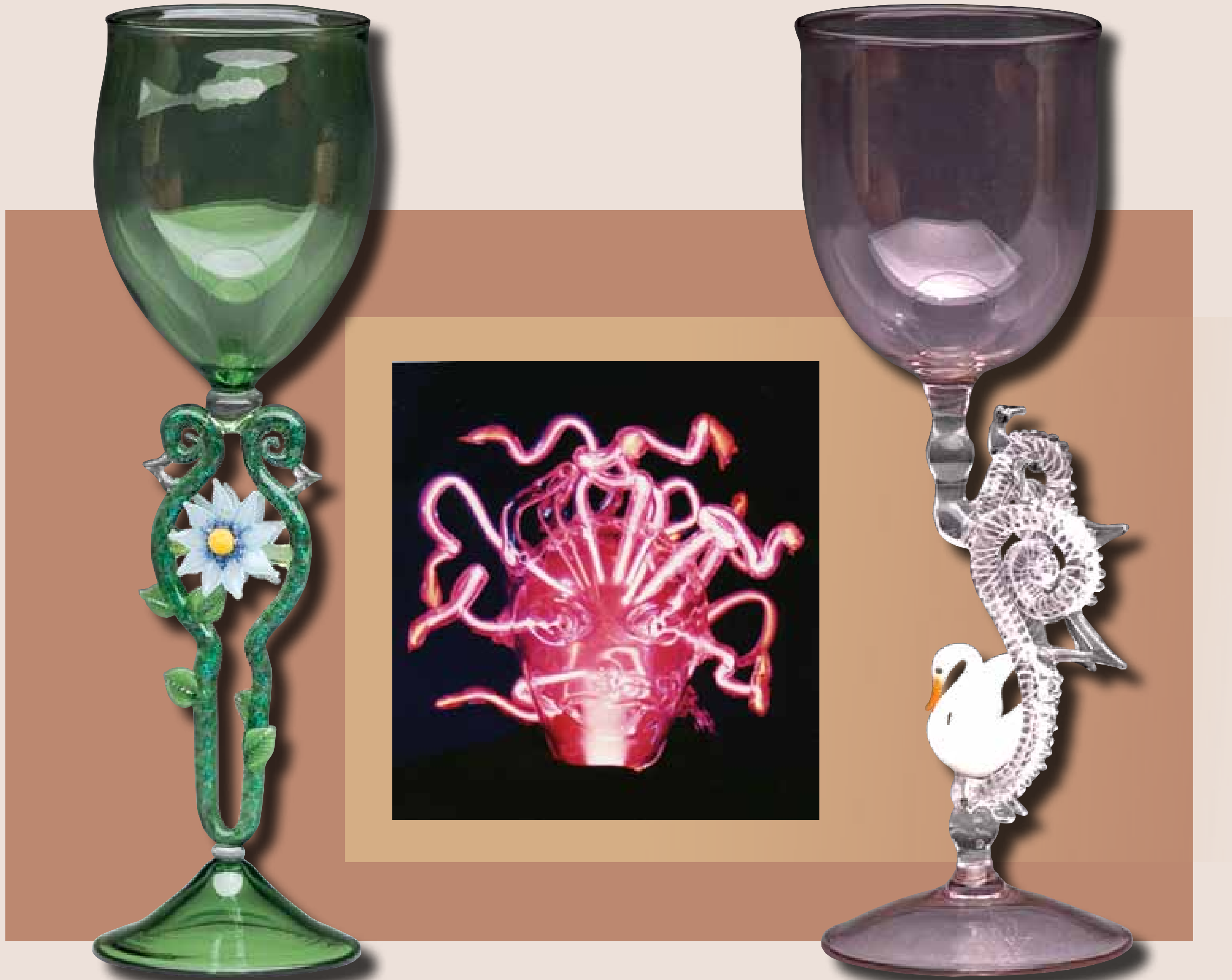
Sometimes when we're making pieces, I'll start the oven and put them in already at annealing temperature, then let it hold for the duration to remove the strain. Then I shock the oven or have it ramp down at a certain cycle so that it doesn't cool too long. A lot of the times those Wilt ovens or some of the other brands, the oven is insulated properly so that it doesn't cool down as quickly.

The pieces probably aren't that thick because they're standard wall, so how do you determine the length of the annealing?

The standard rule of thumb is a minimum of 15 minutes, and it can be 30 minutes to an hour, depending on the thickness of the glass. I've heard some demonstrators say that a quarter-inch thickness of glass is fifteen minutes or more. That depends on how many thicknesses of glass. For instance, when you're doing ring seals, it's not just a single wall anymore. Plus you want to make sure you don't cool that ring seal down too quickly.

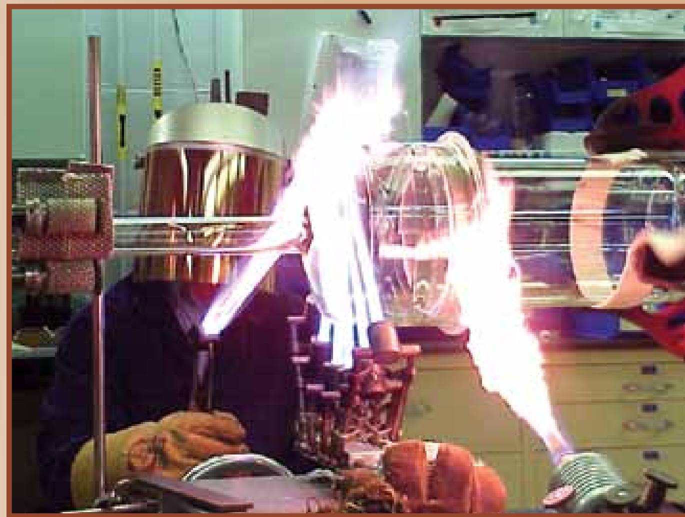
It also comes down into the quality of glassblowing. If you make a ring seal and you don't flow in the tube on the inside very well, you can bring it up and down and it will crack, because you can't have a cleavage. The seals have to be quality seals.

I thought that I saw you once on the cover of *The Flow* magazine



wearing a protective heat suit, and you were on a lathe. I have this wonderful image of you, looking like an astronaut playing with really, really big glass and fire. Can you tell me a little but about your lathe work?

That was on the first women's issue for *The Flow*. They invited me to be their featured artist. I was working on an eight-inch bell jar. I use a lathe on a daily basis. Every scientific glassblower has a lathe. They have usually a stationary bench torch, a diamond saw, a lapping wheel, a belt sander, and the bell jar oven. We also have another oven to do small jobs or rush jobs during the day.



The lathe is really a key piece of the apparatus and is usually for making large-diameter glass that you can't handle at the torch. It's a helping hand to rotate the glass for you. You want to put any of the larger stuff in the lathe, because your arms are just going be tired if you have to keep turning that. You have multiple torches as well, so you have a large face torch with a big fire and two or three different smaller hand torches with different size torch tips so that you can control the amount of heat that you apply to the glass.

I've always heard that the scientific glassblowing field is getting smaller and smaller, yet research and development on an industry and corporate level, I would think, would be expanding. What do you see?

That's a good question, and I don't have the exact answer. Because of the American Scientific Glassblowers Society, if people join the society, then we know where the glassblowers are. Usually it's research and development in corporations. There are only one or two of us. Then there are national laboratories and universities. I'd say right now there are probably about two or three hundred across the country who are members of the Society. We can document where they are, but there are probably at least three times more than that out there.

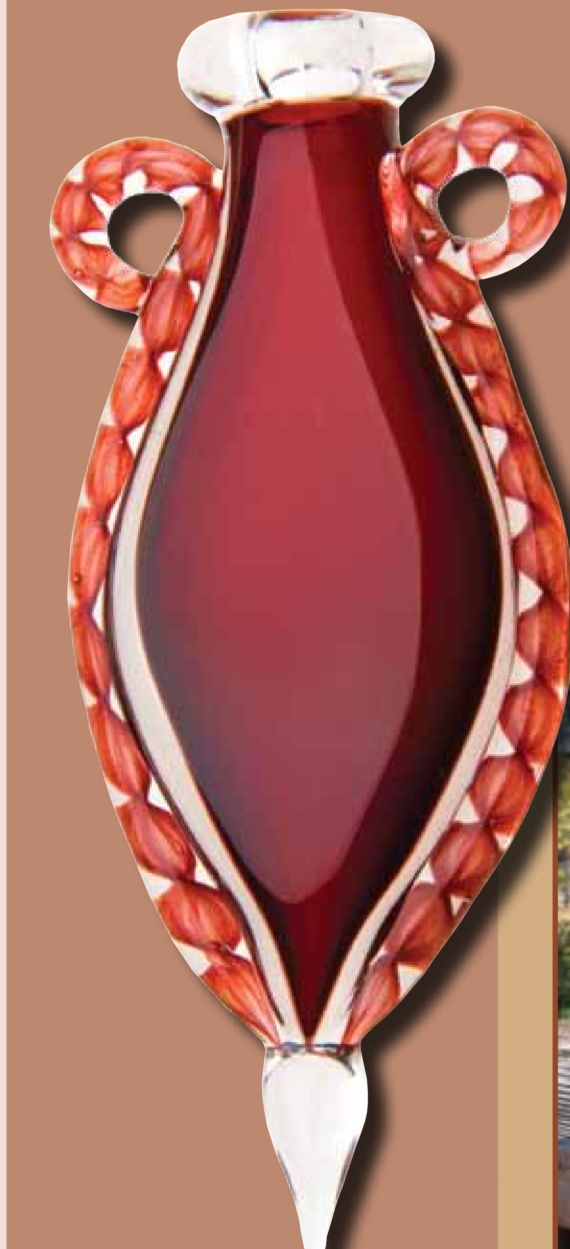
We do see that when some guy retires they don't replace him. It all depends on upper-level management. If they knew that the glassblower was a valuable asset, they will make sure that they replace him. But if there's a little bit of disconnect between the director of a department or a manager, they don't know the value. As glassblowers, we have to continually do publicity on ourselves. We have to continually show our surveys, and we have to take pictures. We have to document. And when we interface with our customers, we have to sell it within the company. The people who don't sell their services are the ones where the doors get closed. It is dwindling, but at the same time there's still work that needs to be done by somebody.

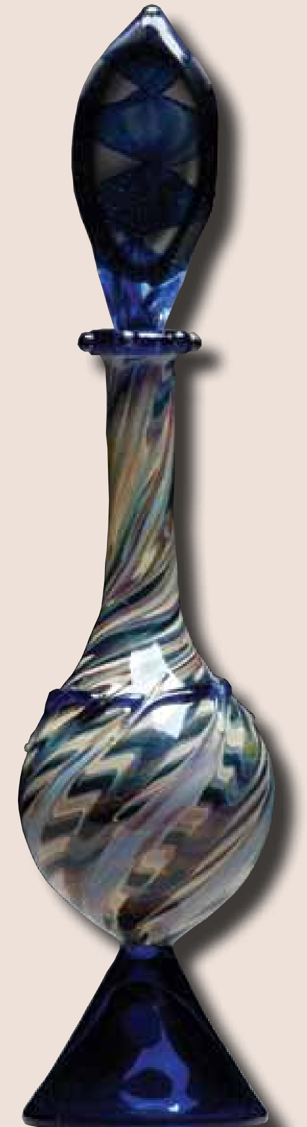
There are ups and downs in the economy and the market, and it's all dependent on the types of research that are going on. When you see cutbacks in different types of medical areas and research, it's going to impact the glassblowers. You can also see this happening in pharmaceuticals and health care. They are doing smaller volume, smaller glasswork, disposable medical glassware. Things change.

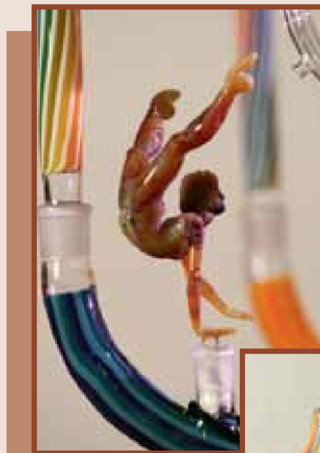
There used to be these things called GC columns that were made by Hewlett-Packard, which are gas chromatography columns. They are long, coiled capillary tube very similar to what I made at the International Hot Glass Invitational in 2009 in Las Vegas, Nevada, for the Cirque du Soleil sculpture. That was an old technique I had learned 20 years ago wrapping coils for what they call HP columns. Now they just use a tiny 2 mm capillary tube—quartz fiber tubes to replace the long glass column that we used to make.

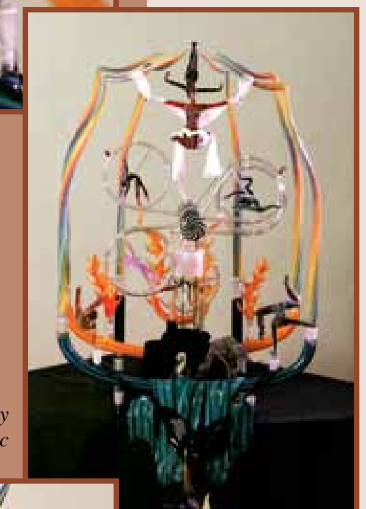
Share a little bit about the collaboration that you did in Las Vegas last year with Julie Riggs.

That was an outstanding opportunity. When I was asked to have a team at the competition, I knew that I didn't want to pass it up, especially since I was the only women being asked. I brought in another girl, Julie Riggs, and my brother. I wanted to be able to incorporate a scientific sculpture. The team collaboration was a great experience for all of us. Julie was in Virginia, I was in Cincinnati, and my brother and his workshop partner were in Portland, Oregon. It was really a challenge to work together being cross country, but we were able to put together this idea and incorporate ground glass joints to build our manifold system, which was the core base of the sculpture.









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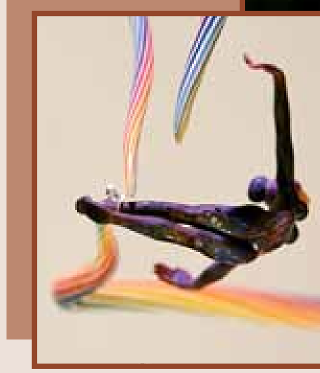

We made a theme called *Elements at Play*, a large sculpture of the Cirque du Soleil show that paralleled the idea of circus tent life, gymnasts, and people flying through the air. We had the contortionist—the gymnast—then there would be flames. We made glass fire that was on a 1420 ground glass joint on the back manifold, and we had tubes that came straight up about 28 inches high that were shaped like a tent. We used the new Glass Alchemy colored striped tubing that had a strip of white in between each rainbow color. That was our tent structure. We had red, yellow, and orange for our flames in the back. Julie made a couple of mermaids that were on the water featured in the front, and some gymnasts were hanging on the tent structures on top. In the middle, it looks like a hamster wheel device with circular baskets where the men would turn while it's rotating around clockwise. There was one piece in the front that was clockwise, and one was turning counterclockwise with the gymnast in the basket who would do all kinds of flips and things. There were three different pieces to the sculpture.

Was it kinetic?

Yes. When you work in research, you've got all kinds of interesting experts in the field from everywhere you go. I talked to the electrician at work, and he was able to help me find out what kind of motors to use and what kind of pulleys to order. I had the machinist help me make some pulleys, and I ordered the O-rings from McMaster Car. I strapped them up through a glass stand that would hook up to my 25 mm tubing, which was the mean core base, and sealed on the coils where the gymnasts were spinning around. We had two belts turning, the front piece and the back piece. Each day I had to figure out another challenge to the sculpture. Bandhu Dunham liked it, and he's putting it in his third book as kinetic sculpture.

Before we go, tell me about the Klein bottle.

It's just something fun that glassblowers make. It's closest to a mathematical Möbius strip, which is one surface. If you take a long strip of paper and fold one side over, then touch it so that it looks like an infinity, then put your finger on one side and follow it, it will go on the inside and then the outside. It's the same thing if you're following the line of a Klein bottle. I incorporated the bottle, then put a goblet bowl on the top and a goblet foot on the bottom. I was doing a technical piece and wanted to show many different exercises in one piece.

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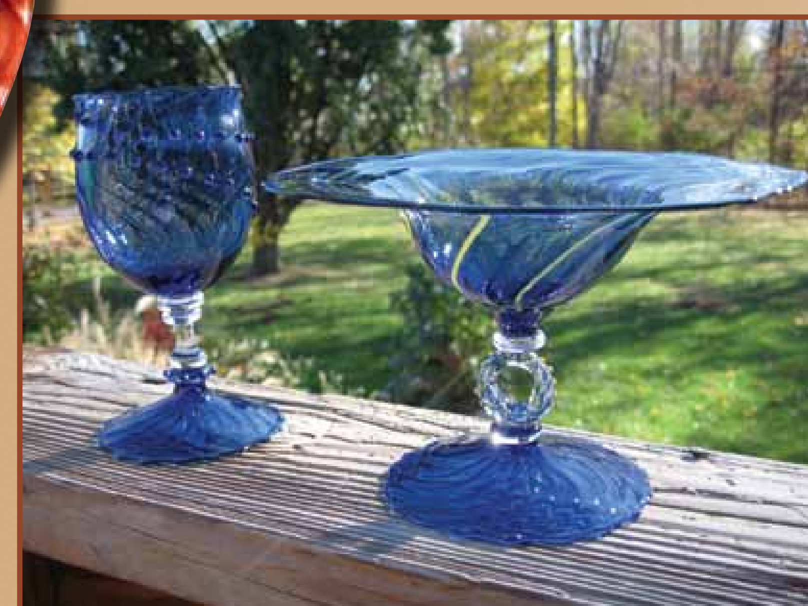

Don't miss the Glasscaster interview with Doni Hatz in the Winter 2011 issue of The Flow *for more on how Doni is finding an artist's voice with her glass in addition to her work as a scientific glassblower.*