
Task Force Meeting

of

ASSEMBLY TASK FORCE ON LIFE SCIENCES

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New Brunswick, New Jersey

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MEMBERS OF TASK FORCE:

Assemblywoman Pamela R. Lampitt, Chair
Assemblyman Upendra J. Chivukula
Assemblywoman Caroline Casagrande
Assemblyman David P. Rible
Assemblyman Samuel D. Thompson

ALSO PRESENT:

Joshua E. Hodes



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ASSEMBLYWOMAN PAMELA R. LAMPITT (Chair): Good afternoon, everybody.

Thank you very much for coming. I am Assemblywoman Pamela Lampitt, and I Chair the Higher Education Committee. And we're very pleased to be in this great science mecca here and be with some really fascinating individuals who have done, already, great work. And we're here to listen to the opportunities where there maybe are some holes in the system. And we're here to listen to where we need to be focusing New Jersey's energies to continue to make New Jersey the mecca for biosciences, life sciences.

We had a fascinating morning, and we're really all very excited about this challenge and this opportunity.

I'm going to allow others to introduce themselves, and maybe give a two-second background, because we have a lot on our agenda today.

Upendra.

ASSEMBLMAN CHIVUKULA: Thank you, Assemblywoman Pamela Lampitt. My name is Upendra Chivukula, and it's a mouthful, and all you have to do is advertise for Pepsi Cola, Coca Cola: drive a Chevy and drink a cola -- that's Chivukula. (laughter) That's how you remember my name.

I am a representative from this area -- District 17, which includes New Brunswick. So I'm proud to be in my district, and welcome all of you to my district. And we are, indeed, fortunate to have such a valuable institution in my district.

My interest is to see how we, as Legislators, can look at the life sciences industry and see how we can come up with policies that really

drive the economic growth and create jobs. And sometimes the legislations and regulations, or even the permitting process, can get in the way of trying to grow the industry; and see how we can understand it first-hand -- the difficulty it is causing. Also, come up with some good ideas so that we can come up with policies to drive this economic engine. And life sciences are a multi-billion dollar business, and we want to see how we can make sure that we continue to retain the name -- that New Jersey continues to be the medicine chest of America. Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you. And later on, I think, we're going to be joined by Assemblyman Thomas Giblin, but-- Assemblyman Thompson.

ASSEMBLYMAN THOMPSON: Thank you.

I'm Assemblyman Sam Thompson from the 13th Legislative District, which is just up the road here. It starts in Old Bridge and goes over into Monmouth County.

I do have a background sort of in the area here -- physical chemistry Ph.D., State Health Department 22 years, and etc. I recognize how vital life sciences R and D and production is to our state and our state's economy. And certainly we want to be able to do everything we can to encourage this further development and growth, and (indiscernible) eliminate those roadblocks that get in the way.

ASSEMBLYMAN RIBLE: Good afternoon. I'm Assemblyman Dave Rible from Monmouth County. I'm the Minority Whip, and it's my pleasure to serve on this bipartisan Task Force which I feel is going to be beneficial to the State of New Jersey.

Our life sciences are very critical. And I think what I'm hoping to take from this Task Force and from the testimony we'll be hearing over the next few months is how we're going to be preserving the life sciences but, more importantly, how we're going to be advancing it in New Jersey, (indiscernible) paramount state of life sciences. And our pharmaceuticals and biotech is so critical to the backbone of New Jersey's economy. We recognize that as Legislators, and that's what we're hoping to get from this Task Force here, and on ways we can do that to make sure we're moving forward faster than the other states.

Thank you again for having us here today.

ASSEMBLYWOMAN CASAGRANDE: Good morning.
Thank you, Assemblywoman Lampitt.

My name is Assemblywoman Caroline Casagrande. I represent District 12, which is a swatch straight across New Jersey, including portions of Monmouth and Mercer County. I had a fascinating morning this morning here -- hoping that we can take some of the information we get as to what your successes are and help replicate them throughout the State of New Jersey. And we are here as a life sciences panel because we know life sciences in New Jersey provide good-paying jobs to our citizens. So it's everyone's intention up here to make sure we provide support and that we in Trenton are doing what we can to grow these jobs.

Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you. This is a great bipartisan group of individuals. We do have Chairman, Assemblyman John Burzichelli who heads the Regulatory -- who will be taking a portion of the life sciences on our succeeding field trip as well. And we also have

Assemblywoman Annette Quijano, who also is on this bipartisan group, coming from the aspect of regulatory, environment, the sciences, and higher education and how they're merging together.

But we're here today, really, to listen. And we're really pleased to be able to have Dr. Rodgers and Dr. Owen here today to give us an overview of UMDNJ, and what UMDNJ is doing and, possibly, what are some of the challenges.

WILLIAM F. OWEN Jr., M.D.: Thank you, Denise.

Assemblywoman Lampitt, good afternoon members of the Life Sciences Task Force. Welcome to the New Brunswick campus of the University of Medicine and Dentistry.

I'm Bill Owen. I'm the University President.

For readily understandable reasons, we're living in a period of diminishing State revenues, so there are less funds available for higher education, especially for publicly funded, State flagship universities like the University of Medicine and Dentistry. For public flagship universities, the coin of the realm is genuinely coin. And I want to begin by sharing with you what are resources of coin.

Revenue sources for health universities like UMDNJ fall into seven categories: The first, of course, is tuition and fees, which vary among the eight individual schools. A rule of thumb: Tuition is linked to what the lifetime earning potential of that student is. So doctors pay the highest tuition, health-related professionals pay less.

Secondly, faculty-generated revenue. Many of our faculty are clinical practitioners and are compensated for practicing their art, and a percentage of their revenue is returned back to the University.

Thirdly, facility-generated revenue. Partner institutions like Robert Wood Johnson Hospital compensate the University for the clinical services provided by our faculty.

Fourthly, development and philanthropic dollars.

Fifthly, Federal appropriations.

Sixth, State appropriations.

And seventh -- much of what we're discussing here today -- appropriations for innovation. Examples include fees paid to the University for the right to use our faculty's inventions; because our faculty are inventors, financial interest in companies that our faculty may start; revenue from those companies, especially attracting the equity interest; and then, of course, grants and contracts, which come from both the Federal government and the State.

The University's budget in FY '11 was \$1.7 billion, with most of that revenue coming from clinical care, State appropriations, and grants in contracts -- in that rank order.

As is the case for most flagship public universities, State-appropriations to offset our recurrent costs have declined over the last five years. By example, from 2007 to 2011, our State appropriation decreased from \$273 million to \$206 million. If I compare that to our base expenses, that's a decline of about 25 percent in that period of time.

Now, such substantial declines in the revenue for any public university are understandable in view of the competing needs that you folks have to balance. I recognize that many of the critical needs that you must fund are not able to revenue enhance and revenue diversify like a university,

but also recognize that in many ways we are being penalized or a victim of our own success.

It's incorrectly perceived that flagship universities, like UMDNJ or our large partner, public institutions, can revenue diversify to make up for that change. For example, an assumption that UMDNJ's doctors, dentists, and nurses can just charge patients more; that our affiliates can be billed more; that we can raise more money from donors; that we can conduct more research, collect more overhead dollars, discover more things, sell access to more inventions; and lastly, raise tuition in an unfettered way are just, quite honestly, simply incorrect.

Many of the public-funded universities are having an increasing difficulty balancing expectations and needs. And by expectations, they are the things that we accept (*sic*), and the things that you rightfully expect of us. They are things like meeting our medical social mission of caring for all patients, independent of their or our financial state. It's prioritizing the development of social assets for the State. It's making certain that we have a health workforce that reflects New Jersey.

Now, peer universities around the country have met these challenges by reducing their recurrent expense base, diminishing the quality of their instructional programs, striving to privatize and/or exploring new revenue sources. Now, I want to just take one moment to look at UMDNJ. We have cut our recurrent expense base so much that the quality of our instructional programs are actually increasingly threatened. When I talk about privatizing -- about privatization, I am not using it as the typical descriptor in the public sector in New Jersey. In the situation I'm describing herein, privatization is being used to refer to changing the

number of students who are from in state as compared to out-of-state. Out-of-state students in many universities pay three times as much for tuition. So by changing that ratio it becomes a way of changing resources to the university.

I underscore that we do not want to take actions of this sort, like raising tuition, compromising the quality of our programs, excluding in-state students, or have the dollar follow the person in a mercantile way. But we must revenue enhance and we must revenue diversify. There is a need for innovative ways for institutions of higher education in New Jersey to monetize their assets. We all want to be educational workhorses that can run with racehorses. We want, and we think that you should demand, higher performance in this area for us.

Although you're here today to begin to identify approaches to enhance New Jersey's knowledge-based economy, it's with a very selfish and self-serving intent that I am here to advocate for the University and those it serves. And so on that background, I encourage you to be stalwart in your attention to the life sciences as an unfulfilled avenue for economic growth. Why health-based model for economic development? First, Americans are addicted to health care. Health-related expenditures in the United States account for 17 percent of our GDP. Over \$1 trillion a year is reproducibly expended somewhere on something to deal with health care in America. And it's a fair question: Why shouldn't New Jersey help spin some of that money?

Secondly, demand for health sector employment remains high. As manufacturing positions in the United States have declined, they are being replaced to an equivalent -- and contemporary data suggests even an

accelerated -- rate by jobs in the health industry that typically pay more per hour for a given educational level than those in the traditional service or manufacturing sectors.

Thirdly, employment in the health sector is a natural progression from training for a job to training for a profession. Let me give you an example: A high school graduate can be trained in one year to be employed as a dental assistant by a trade program at UMDNJ. After another two to three years, that same person can be trained as a dental hygienist, also at UMDNJ. They can go on further, to pursue a terminal degree in dentistry, of course, at New Jersey Dental School. We have two examples of leaders in this University who have followed that same path, so this is not fictional. Health care is one of the few professions where one can almost seamlessly progress from a trade to a profession as a pipeline -- and that's unique.

Fourthly, New Jersey has a mature, high-performing academic health university. You're on one of its campuses right now. Despite rumors of an irrevocably tarnished reputation for UMDNJ, I'm here to tell you they aren't true. Although Oscar Wilde said it's better to be spoken of badly than not spoken of at all, when was the last time you read a titillating article about malfeasance at UMDNJ? I think it's been a few years.

Health universities like UMDNJ are a repository for terrific ideas and a brain trust for inventions that can be monetized. And most new health discoveries are made in universities -- not within the pharmaceutical or the device industry. Moreover, let's not forget, as was mentioned in the opening remarks by the Assemblywoman, we've

extraordinary access to pharmaceutical partners in New Jersey to bring value and human benefit to our ideas and our inventions.

I similarly hope that this panel will dedicate energy to better understanding the correctable barriers to monetizing our State university's intellectual assets. I contend that it is not by happenstance that North Carolina, Massachusetts, Michigan, Wisconsin, Washington, California, Maryland, Illinois, etc., so readily outperform New Jersey in this sector.

I think that you will find that the answers to those questions align as much with the need for a more audacious, performance-based vision for higher education in New Jersey, as much as the need for increased resources in this area.

Last, as your work proceeds, I personally extend open invitations to each of you to avail yourselves of any of the intellectual resources and expertise that are available on this campus.

I want to thank you again for kicking off on this campus, and your patience in hearing my musings. (laughter)

ASSEMBLYWOMAN LAMPITT: Thank you very much.

Dr. Rodgers.

I've had the pleasure of working and speaking with Dr. Rodgers, and clearly she represents the quality of UMDNJ and everything that's really very good about UMDNJ.

DENISE V. RODGERS, M.D.: Thank you.

Madam Chair and members of the Assembly Life Sciences Task Force, my name is Denise Rodgers. I am the Executive Vice President for Academic and Clinical Affairs at UMDNJ. In my position, I provide oversight to the eight schools and two clinical units at the University.

As a statewide institution, many people are unaware of the depth and breadth of educational programs in the life sciences at UMDNJ. The University is composed of three medical schools: New Jersey Medical School in Newark, Robert Wood Johnson Medical School here in New Brunswick, and the School of Osteopathic Medicine in Stratford. New Jersey Dental School is the state's only dental school and it's based in Newark.

We also have a School of Public Health, a School of Health Related Professions, and a School of Nursing. You will hear more about our eighth school, the Graduate School of Biomedical Sciences, throughout the afternoon.

At UMDNJ we educate approximately 6,000 students each year. Our two clinical units are University Hospital in Newark and UBHC, University Behavioral Health Care, which has a number of sites located throughout the state.

As a health sciences university, our mission is to train students from a wide variety of disciplines in the biomedical sciences. A significant number of our graduates provide direct patient care or other healthcare services. Others are engaged in basic science or clinical research, while some of our graduates are in administrative or policy-making roles. In our School of Health Related Professions we have educational programs that range from high school to Ph.D.-granting courses. All eight of our schools provide doctoral level training in one form or another. As part of that training we hope to spark student interest in biomedical research.

There have been a number of studies directed at determining the requirements/priorities for a competent biomedical sciences workforce.

The most successful researchers in life sciences fields are those who have a strong science or math background, but also possess problem solving, critical thinking, and team-building skills which allow them to spread their talents across all aspects of the organization. This is something that, years ago, we didn't recognize as much as we do today. Moreover, given the global nature of the research industry, cultural competence and the ability to interact and communicate with diverse populations has become a key workforce need.

I think another thing that's critical to developing a powerful life sciences workforce is collaboration among academics and industry, not at the end of the training period when we are trying to place our graduates, but in the development of curricula that will make them attractive to and successful in the life sciences fields. Historically, universities have had a tendency to design, develop, and peddle their wares to industry -- this is true in both research and education -- without necessarily consulting with industry regarding their needs. In recent years, that has begun to change, and I believe that the key to developing a strong New Jersey workforce is to refine and enhance those collaborations, perhaps even formalize them, as we move forward.

Let me tell you about a few programs that we've developed at UMDNJ to help address this issue.

We have a Master of Science in clinical trials at our School of Health Related Professions, which is directed at college graduates to train them in various aspects of clinical trials, regulatory issues, trial design, informatics, patient recruitment, scientific writing, and cultural competence.

We have a Master of Science in clinical translational sciences, which is directed at MDs, Ph.D.s, and PharmDs, and dentists. It's designed to train future team leaders in clinical and translational science research. Graduates of this program will utilize the knowledge obtained to design and oversee programs, facilitate and manage collaborations, and lead research teams in clinical and translational research.

We have a Master in Molecular Pathology that's in formal association with Medical Diagnostics Laboratories and HUMIGEN, the Institute for Genetic Immunology, both in Hamilton, New Jersey. This collaboration is with our Graduate School of Biomedical Sciences at the School of Osteopathic Medicine in Stratford, and is offering a graduate program that is designed to prepare students for careers in diagnostic, immunology, molecular biology, and pathology laboratories.

We offer a Certificate in Recruitment Sciences, which is to develop and validate strategies for clinical trial subject recruitment and retention.

We offer a Master of Science in Health Sciences in the Clinical Laboratory Sciences track, again at our school of Health Related Professions, aimed at training students to keep up with advancing changes in the clinical laboratory sciences.

And lastly, we have a Biomedical Informatics program. Increasingly, computing systems and technologies have become essential for the modern practice of medicine, pharmaceutical and clinical research. To address an increasing demand for well-trained researchers, educators, and managers in the expanding field of biomedical informatics, and a growing critical need for informatics training, the Department of Health Informatics

offers a comprehensive curriculum leading to a Ph.D. in Biomedical Informatics. We also offer a Master of Science in Biomedical Informatics, as well as a certificate program for people at the baccalaureate level.

I have attempted this afternoon to give you a flavor of our industry-enhancing programs as part of my remarks. It goes without saying that we also train students to work to develop cures for the diseases that plague us, and other interventions that will extend and enhance the quality of life for the residents of New Jersey and throughout the country.

Thank you.

ASSEMBLYWOMAN LAMPITT: Well, thank you both very much. I know we all have questions. I have a few of my own.

Dr. Owen, you stated the appropriation, obviously, from the State of New Jersey has gone down, and you also stated that we have 6,000 students who you educate. Has the number of students that you're able to educate -- has that gone down due to the appropriation?

DR. OWEN: We have not had an adverse impact on the number of students. My greatest concern is, of course, about the quality of programs. Because as I described, it truly is a case of a trade off. And I certainly can cut out our recurrent expense base by changing classroom size, resources, the laboratory, how they spend their time. We made a commitment to not touch that; but on the other hand, something is going to have to give. And hence the importance of revenue enhancement and diversification, like you're talking about here.

ASSEMBLYWOMAN LAMPITT: When you spoke briefly about the initial -- what could happen with a high school student, and how they could get into the life sciences just as easily as taking one set of classes

or courses here at UMDNJ. And you said this happens frequently. If somebody starts off in the world of the dental field, and they take that one year, how many individuals stay within UMDNJ? You might now have this information, but how many of them actually go through the process of continuing their education? And if they do this, is there some sort of financial benefit to them through the process of the educational-- The expense to the person themselves, and obviously then their earning potential as they're going through this process has grown.

DR. OWEN: I'm going to deal with the last questions and answer the quantitative one -- and just pass the quantitative one that you started with to the Provost.

In terms of the benefits to those students, the first one I want to call out is that entering the health sciences, you are very much training someone who is a life-long learner -- at least I hope you are. These are, by definition, disciplines that are not static. There is an expectation, and there is, hopefully, an installation of love of learning. And whether it occurs in a classroom pursuing an advanced certificate, or an interminable degree, or it's picking up a journal, or watching the History Channel or the Nature Channel, you've made a life-long learner. And in that way you have contributed to a knowledge-based economy.

In terms of the finances, the data is overwhelming. Just as a baseline, if I look at the number of years that are spent training and the end goal with a knowledge-based type of employment, it's higher. Many -- albeit I can't comment how many -- will go on to pursue advanced degrees.

And maybe the Provost can comment about that.

DR. RODGERS: We aren't able to keep actual data about the number of students who sort of track from one discipline to another, for example, dental assistant to hygiene. We have a fair amount, though, of anecdotal data that would suggest that what people do is-- So they'll become dental assistants, and they'll work for a number of years in that field, and then decide they want to do more. And then they'll come back to school and do dental hygiene for awhile; and then perhaps decide that they want to pursue further education and go to dental school.

We see this a lot in nursing, as well as-- I was actually just talking to a nurse from this hospital -- from Robert Wood Johnson University Hospital -- last night who has been in nursing for 20 years and decided to just go back and get her Bachelor's degree. We see a lot of those students.

ASSEMBLYWOMAN LAMPITT: Is it 30 percent, 40 percent? Part of the industry that you're seeing -- is it a significant amount?

DR. RODGERS: Again, hard to tell. And it varies from discipline to discipline. So, for example, let's take nursing. What we know is that as hospitals obtain magnet status, they're required to have a higher proportion of nurses with terminal degrees. And so yes, so we're seeing in the nursing profession a significant proportion of them. Now, I have to add as a caveat: not all of them come to us for continuing their education. And that's where it also gets difficult. So some students may start out with us and then go someplace else, or we have students who start out at other institutions and then come to us. So that tracking gets a little bit more difficult.

ASSEMBLYWOMAN LAMPITT: I would ask that maybe you'd be a little brutally honest with us, Dr. Owen. We need a little bit of real honesty here. And you don't come from New Jersey; you know my history -- you looked me up -- you know that I don't come from New Jersey either. And you stated some other states that are much more progressive than we are in terms of the happenstance of how this process works. And the STEM initiative is not something new to the terminology here in this room, and it's certainly not new to the Federal government, where President Obama is very focused about the STEM initiative as well. There are states - - and you didn't mention this one, I'll mention this one -- Kentucky, where their government and their higher education has really taken on a very strong initiative; where they have developed a real strong mission statement in and measures.

And I just wanted you to be a little bit brutally honest with us about where do you think we need to go in the State of New Jersey to help move this STEM initiative in the direction of higher education, K-12? To be better in delivering a better product to you so that when you receive these students you're working with maybe a better formation of clay. Because you take them and shape them and mold them. But the molecules that are put together to form that clay are better and more cohesive, so that when they are here-- And that cohesiveness -- actually you're better at producing when they get here.

DR. OWEN: You don't have to worry about me and candor -- what you see is what you get, because I'm from Tennessee. (laughter)

But in terms of actually the entry and what those students look like: I'm going to ask the Provost to comment, but I do want to just call

out some distinctions in my career, because I've been in a lot of places -- Massachusetts, Illinois, Tennessee, North Carolina -- and these are states that have very mature programs that are focused on monetizing intellectual assets.

One of the things that's really striking for me is the way science and higher education is valued here. And I'm going to return to North Carolina as a paradigm of the difference. Think about North Carolina first. I went down there from Massachusetts to Duke. North Carolina was an agronomy-based economy. This was a state that was an agricultural state. What did you do when you grew up? You worked on the farm, you grew tobacco. Guess what? All of a sudden the ability to grow tobacco disappeared. So under some striking leadership from the executive and the legislative branch, there was a vision -- that was my one line that I made earlier -- set for higher education in the state. And that's -- to trivialize it, "We're going to convert to a knowledge-based economy. We're going to take these kids and we're going to make sure that they have access to higher education. And we're going to form a terrific pipeline to do so."

So hence, North Carolina School of Science and Math identified the best and brightest: "We don't care what farm you came off of or how poor you are. And we're going to put you in a boarding high school, and guess what? After you graduate, you're going to go to college in North Carolina, tuition free, so that MIT and Harvard and Stanford, you name it, doesn't come in and scoff you up. And once we've got you there, we're going to keep you in the state."

It is not a coincidence that the Research Triangle Park, a half-billion-dollar-a-year biotechnology park, exists in North Carolina. It's not

by a coincidence. Think about it: The sons of tobacco farmers are now the vice presidents of Bank of America in Charlotte.

I can continue on and on. So a bit of preaching here, but this goes back to the issue of -- and I pose it as a rhetorical question -- what is the vision for late K-12 and higher education in the state? I'm not sure I fully know what that vision is. Are we to be an incubator for life-long learners or great professionals who stay in this state?

DR. RODGERS: Just to follow up: I think that one of the challenges we face in New Jersey, that's not that dissimilar to other states, is students who aren't as prepared in math and sciences as we would like them to be when they come to us. We have high school curricula and, in some instance, quite frankly, undergraduate college curriculum that really don't have these students prepared to deal with the rigors of the sciences that we're teaching; quite frankly even to deal with the rigor of the educational programs that we're having. I was reflecting, actually, on the presentation that you all saw this morning with the slides that we showed you. And it occurred to me as I was watching this that one -- I believe that one of the goals that we want for New Jersey is that in the not-too-distant-future we want every high school graduate in this state understanding what DNA is, and understanding how DNA is related to proteins. This is the way of the future. This is the way we're going to begin to think about -- hell, this is the way we're going to develop interventions. Students need to understand what genes are. Students need to understand what genes do in the human body. And I don't think that-- First of all, they get a lot of it -- the lingo -- on television, so some of the concepts are there; it's just putting it into reality would be helpful.

ASSEMBLYWOMAN LAMPITT: If you could make a video game with it, I think that it would be helpful. (laughter)

DR. RODGERS: I think you're probably right. One of the other points I was going to make is: Students are very facile in the language of computer technology. They know what gigabytes are. They understand what that technology is about. We need to help them have the same burning desire to understand the health sciences, as well, so we can do a better job of competing. And we need to put resources into it. And we need to reward students for it, so that there's a way in which we incentivize students to go into sciences and then to continue their education into the health professions. Because the one thing we know -- probably sadly -- is that as long as there are human beings there will be illness; there will be a need for the health professions. I think as the science gets better and gets more complex, the needs are going to be even greater, but the needs for a well-trained workforce are going to be even more imperative. And a lot of that foundation has got to be begun in the K-12 arena.

ASSEMBLYWOMAN LAMPITT: Thank you both.

Questions?

ASSEMBLYMAN CHIVUKULA: Thank you, doctor and doctor.

A question in terms of-- There's always this-- You hear about a lot of the New Jersey students, they get their education and they leave the state. Or that we don't attract that many students from out of state coming into here. So why do you think the students leave New Jersey? I know North Carolina has a good football team and basketball teams (laughter). But apart from that, if we--

ASSEMBLYWOMAN LAMPITT: You're not really dissing Rutgers, are you? (laughter)

ASSEMBLYMAN CHIVUKULA: No, no, I said why are they going to North Carolina -- they should go to-- They talk about Duke, and all that stuff. I'm not a big sports guy. (laughter)

But I think the question I want to understand is why-- Isn't that a brain drain? Losing some children who have great potential, losing them to other states? And what can the state do to keep them in the state?

DR. OWEN: You can take it first, then I'll pick it up.

DR. RODGERS: When we talk to the students, a lot of it, quite frankly, is the cost of living. It's not rocket science, actually, unfortunately. It really is. It's expensive to live here. Certainly if you look on the medical student side, obviously the other variable has to do with the malpractice environment as well, which is a more difficult environment.

I think that there are, perhaps, other factors. When you really do a national-level research in looking at this, some of it has to do with family ties. And so what we see is the influx of students that we get who go to other institutions then come back to us, as well as students who stay with us. It's generally because they have family ties. Either the student themselves, or their spouse or partner contribute to those kinds of life decisions. So it's actually very complex. But lowering the cost of living here would, without question, be helpful.

ASSEMBLYMAN CHIVUKULA: I don't know that that's feasible. (laughter) (indiscernible) we all want to go do Broadway; we are close to New York City, so everybody's cost of living, naturally, goes up.

But in terms of the private sector stepping up -- because the State's dollars are diminishing and we have a fiscal situation -- and the private sector coming to the aid and trying to create some internship programs to attract the students-- So that way you can increase the private sector investment. I think when you talk about kids who (indiscernible) education, and trying to create dental assistants, or you want to create some kind of technician jobs and all that, I think we need to get the private sector involved. And so that way-- That's where it's going to be in the future. I don't think any government anywhere in the world can afford to continue to pay like this. And so I think-- What can we do, or what can you do as heading the great institutions, to engage the private sector? There are a lot of things written about, saying that people are going overseas for research and they're trying to do clinical trials overseas. What can we do as a State to attract that private investment, as well as engagement? I think that's the most important thing. People have to realize that we have been supporting these companies, and their drugs and all, for a number of years, and they should invest in our State so that we can create that type of skilled workforce.

DR. OWEN: Assemblyman, I'm going to return, for just a moment, to your first question. And I'm going to speculate with an answer that isn't necessarily as much an issue for this panel, but I do think is an issue for you folks as Legislators; and Legislators who are ultimately going to have to work with the Executive Branch, from the Kean Commission and the Higher Education report.

There is a series that has recently been developed by the *Chronicle of Higher Education*, which is basically our trade journal. And it's

posing a fascinating question, and that is: What is a quality education? And it seems a trivial question, but is a quality education based, as an example, on the SAT scores of the students who come there? Is it them getting jobs? Is it reputational, based on how many grants you have, how many professors you have who are men and women of letters, etc., etc.? The point I'm making is there is not a good definition of what a quality education is in America. And it becomes a real problem when we have an Executive, a Presidential mandate to have X number of students graduate from college in America. Well, okay fine -- I get the number up there, but if the quality is not there?

Where I'm going with this is, because there is no definition of what is a high-quality education in America, much of student selection is based on -- what a surprise -- branding. So I think that everything that the Provost described is absolutely right, but I will tell you, having a youngster who was just last year trying to decide about college -- all I heard about was reputation of places. And when I said, "What the heck does a reputation mean?" it was a lot of flummery there. So I'll just-- Next question, please. (laughter) She's much smarter than I am. I conceptualize.

DR. RODGERS: I'll address your second part, and I think that some of the programs that I described in my testimony are very concrete ways in which we're trying to partner with industry.

One of the things I didn't mention here is that we're also developing programs specifically for industry employees, so that they become more facile in clinical trials recruitment and that sort of thing. And I think the degree to which we engage them in saying, essentially, "We have

something that will be very helpful to you; now let's figure out how you can help us," may help to further facilitate these partnerships.

What I can really assure you of is, if you look at UMDNJ 10 years ago, and the degree to which we have conversations with, and integrated programs, and the development of new curricula and research initiatives with pharma, it has grown exponentially. And I'm hoping that we will see that continue to rise as well.

ASSEMBLYMAN CHIVUKULA: Just one final question here. I know I'm dominating.

We do have-- A number of things -- I want to make sure that these things are working. We do have technology innovation zones under an executive order by the Governor -- previous Governor -- in Newark and greater New Brunswick, and the Camden (indiscernible) around the technology innovation zones. That should be an incentive for companies to come in and do that thing. Then we do have -- under the New Jersey Labor and Workforce Development there are training grants that are available for you to set up schools -- training schools, institutions -- for training people to become dental assistants and medical assistants, whatever that might be. And then we have-- Until recently we had a New Jersey Commission on Science and Technology, which had a \$10.2 million budget that was cut to zero, and we don't have that. And there was-- Because you are a research institution, we had a program in the Commission for a technology -- a research fellowship program, where there is a certain amount of money, 50 percent match by the private corporations for a Ph.D. student to do their post-doctorate. They can go into institutions such as yours and then they can get training. So that that way we can promote the research.

I think that those types of programs are essential in terms of increasing-- The cost of living, you're not going to bring down in New Jersey. The only way you can do it is, we can create high-paying jobs. And high-paying jobs, in a sluggish economy, are in research. And especially the clinical research. And life sciences can play a real important role. Because if you look at all of the bioengineering -- surveys showed that it's one of the only industries that have increased the number of jobs -- from 10,000 in 2007 to 15,000 -- and retained a number of companies. Their retention of companies went from 300, and then attracted another 200 companies.

So there a lot of things happening, and I think-- Are we doing something-- We may have all these programs, but are they disconnected? Or how can we bring them all together so that we can really make New Jersey institutions centers of excellence?

DR. OWEN: I certainly don't know enough about them to comment. But I will say this: A state like Tennessee, which is where I was also in a previous life-- And you say, "Why the heck would you talk about Tennessee?" FedEx, International Paper, Oak Ridge National Laboratories, University of Tennessee -- in fact, we ran St. Jude's. It is the one-phone-call model. I make a phone call into the executive's office, and I've got a SWAT team that's available to me as the CEO of a firm. And they are going to get me plugged in to everyone. And maybe we don't have that here; if so, I apologize for not knowing about it. And by the way, having been on that side -- I was chief scientist at Baxter -- you get one phone call. If I get frustrated, I'll never call back again.

DR. RODGERS: I don't want to belabor this answer, but I think one of the obstacles we have at UMDNJ -- and this has historically to

do with how we were originally established -- we're not able to give first degree bachelor's degrees. And so a student needs to have a bachelor's degree in something else in order for them to come to one of our bachelor baccalaureate degree-offering programs. And so it's a stumbling block for us in participating in some of your programs, because some of them really are entry-level. And obviously we partner with a lot of community colleges and other universities -- colleges and universities throughout the state around that. But for us, specifically, just to make you aware of that glitch.

ASSEMBLYWOMAN LAMPITT: Thank you, thank you all.

Assemblywoman Casagrande.

ASSEMBLYWOMAN CASAGRANDE: One question; thank you very much.

I think this question is directed towards Dr. Rodgers. And thank you both for your testimony today; it's been very informative.

I was very interested to hear about your new program in Biomedical Informatics. And I read the description and heard your testimony, and a few things went through my mind. The first one was, does this type of degree, does it have anything to do with what we heard about during the stimulus -- which was codifying, and money that would be given to codifying all sorts of medical records and getting us all on an electronic system? And secondly, are you partnering with any companies in New Jersey to send your graduates to, or are you growing those jobs? What's going on in that field, because it sounds like a great new area where we can become a leader.

DR. RODGERS: It absolutely is a terrific area that we're very excited about. I don't believe we're partnering with any particular

company. I certainly think that the people who are involved in teaching in that curriculum are aware of some companies, but what I will say is that the opportunities for those positions are going to substantially increase as we figure out what meaningful use of data in the electronic health record is going to mean. So that's one area in which we will be able to have students kind of able to help health systems kind of figure it out.

But the other piece is, we're doing a lot more with computational science on the research side as well. And so we want to give people a foundation for being able to participate at that level. So what we've showed you today were a lot of ways in which we use animal models in our research. Well, we got a whole lot of other ways where we use computerized models in our research -- where we do things almost like the computer game kind of way, except at a much greater level. It gets way beyond my level of comprehension, quite frankly. And so again, we're trying to educate a cadre of people to be able to work in those fields as we think about this.

ASSEMBLYWOMAN CASAGRANDE: Off the top of your head, are your graduates going to New Jersey companies? Do you know, generally speaking, where some of these graduates for Biomedical Informatics are going?

DR. RODGERS: Sadly, I do not know. But I can get that information for you.

ASSEMBLYWOMAN CASAGRANDE: Okay, great. Thank you.

ASSEMBLYWOMAN LAMPITT: Assemblyman Rible or Thompson?

Thompson? Thank you.

ASSEMBLYMAN THOMPSON: Thank you.

As we said earlier, our primary purpose is to devise means to encourage the development, growth, retention of work in the life sciences area. The obvious way to do it, first thing that comes to mind, always is put more money into it (laughter), either in terms of into UMDNJ or the programs that were mentioned by Assemblyman Chivukula. But of course our financial resources are going to be rather restricted for awhile. So I'm wondering if either of you might have some other suggestions as to actions that we could take or recommend in order to encourage work in this area, or make it better for people to be able to go in it, or to do what they need to do, or etc. You did mention, Dr. Owen, the one-call system. I believe it was announced a couple of months ago they have established such a program in the Lieutenant Governor's Office. But if you have other such suggestions that-- Again, things that we could implement through regulation, statute, or whatever, that would aid life science firms to do R and D in the state and come in, or stay here, or expand. Do you have any suggestions along those lines?

DR. RODGERS: Well, certainly for me, obviously on the academic side, in whatever ways we can develop loan repayment programs, for example, that, again, incentivize students to go into these fields. I think that Assemblyman Chivukula's whole idea about ways in which we do a better job of partnering with the private sector-- I mean, the way we get the private sector to actually invest in some of our educational programs -- obviously with all the appropriate compliance mechanisms -- so that they really see that we are training the kinds of students that they're interested

in and therefore it's worth their while to invest in us. And quite frankly, I do believe that on the legislative side that's where there's potential for you to help us in a regulatory way to kind of facilitate that. I mean, we don't want to cross certain boundaries around that, but I also think we don't want to put up unnecessary obstacles in terms of our ability as an academic institution to partner with pharma, in particular, in an ability to create some innovative opportunities in education and research as well. And I think, quite frankly, we do it much better on the research side than we even do on the education side.

DR. OWEN: You folks are legislators, so you'd be able to tell me if this is a legislative fix. But I will go back to a previous life where a peer vice president took the greatest pride in how many factories he could open. And he would go from place to place around the globe opening factories. This was when I was at Baxter. And I remember being part of a team that was discussing where to open a factory. And I was the dumbest one in the room, clearly. And I thought, "Oh, tax incentives." And what I realized very quickly was it was actually about the workforce -- and two aspects of the workforce. The first one was, interestingly enough, the health of the workforce -- what is going to keep that employee there and make him or her productive. And I'll give you an interesting example, and that was, we talked about why do mothers who have school-age children miss work? And the most frequent reason was that they were home taking care of their children. And the most frequent reasons that the kids were home was caries -- so basically, bad teeth -- and asthma. Hey, guess what, folks? These are things that are very manageable illnesses. And when you look at the impact

on a P and L of someone who's missing work or, more importantly, I'm having to insure that family -- those are real easy fixes.

The other was actually the pipeline of the workforce. What was the ability to have a workforce that was trained and knowledgeable and, at the end of the day -- Bill Owen's descriptor is a life-long learner -- so that I can transfer them from one area in the firm, or one area in that factory to another.

Where I'm going with this second piece is -- and this is Bill Owen speaking as Bill Owen alone -- I do not think it is unreasonable to speak to large corporate partners and ask, no kidding around, what do you need for your workforce over the next five years? And if they tell you they don't know, they're being disingenuous, because absolutely they do -- and especially in the life sciences. Every pharma company can map out for you -- and I know they have it -- what drugs they're planning to introduce when. So they have mapped out in parallel with their HR group what kinds of people they're going to need at what phase in drug development. And guess what? We've got a big pharma industry here.

So I don't think it is unreasonable to demand of our higher education institutions to partner in a real sincere way with these megalithic firms and make sure that you are developing a workforce for them. That should not be our sole intent, but it's certainly something that seems to me it would make us pretty doggone attractive. And as a final point, Toyota is in Mississippi for a reason other than crawfish. (laughter)

ASSEMBLYMAN THOMPSON: Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you both very much.

I just have one final question -- well, one final thought and one final question. Have you developed-- You spoke, Dr. Owen, about schools in North Carolina that are specifically driven towards-- Have you developed your own set of programming, your own feeder programs that have developed for you specifically, that quite possibly could be shared with others within the State of New Jersey? One of the things that I have found being in New Jersey -- probably you as well -- has been the silos that we have here. Yes, the silos and the home rule. And one of the things that, you know, unless you have opportunities like this to share amongst ourselves, then a lot of sharing doesn't occur. So one of the opportunities-- When you start talking about STEM and STEM initiatives, one of our findings was that the Girl Scouts -- strong leadership, strong women, breeding strong women into leadership -- and they have a real strong niche focus about the STEM initiative. And where have you, maybe, taken some of these opportunities to reach out to outside of what would be the norm to find that feeder opportunity for UMDNJ? Or haven't you?

DR. OWEN: Provost, you want to talk about your pipeline program?

DR. RODGERS: Well, we actually have a range of pipeline programs. We have health profession students who go and work primarily with middle school to high school kids -- we're not as much in the elementary schools -- talking about science, talking about health, that sort of thing -- talking about healthcare professions. We have joint programs with some undergraduate colleges where we create six-year programs so the students can come in, do part of their undergraduate work, and then the

last part of their undergraduate work they do in combination with medical school.

We haven't started working with the Girl Scouts yet, but I like this idea, so I'm going to go back and sort of noodle on that one, particularly since my daughter is a Girl Scout.

So I think we have actually been very successful in working in the variety of communities where we're located, with really reaching out to those communities to get kids at the, again, middle school and on up level to develop pipelines.

ASSEMBLYWOMAN LAMPITT: Thank you.

My final question is this: We've been talking so much about students themselves, but without having the great professor in front of them we are for naught here in the State of New Jersey. So again, the brutal honesty that you've delivered thus far -- we appreciate it -- where are we going wrong in terms of trying to draw and attract the diamonds in the rough, the Dr. Rodgerses, the Dr. Scottos, the diamonds in the rough to come to New Jersey, to be the educators of our students? And what could we be doing differently?

DR. OWEN: I'm going to definitely have our Provost talk about this. She's passionate about it.

DR. RODGERS: Now you've really asked the right question, because while we're not having trouble with students, we're having tremendous trouble with faculty. So over this period of time where we've decreased our State appropriations, we have lost faculty. And in losing faculty, it's almost like we're becoming a little bit of a farm team for other local institutions' academic health centers. Because of the situations here,

sort of, our mid-career up-and-coming folks are being recruited away and we don't have the resources to actually bring them in. So basically what I'm saying, if we lose an associate professor, we're having to replace them with an assistant professor who's not yet able to bring in the same levels of research, who doesn't have the same kind of national reputation and all of that.

There are a number of things that are happening in the state. Obviously the whole change with pensions-- And you know, I understand at some level, the dilemma. So you look at a bunch of doctors and you say, "Oh, you make a whole bunch of money, and you don't deserve this and you don't deserve that." So from a taxpayer standpoint I understand it, but also that's not the real world in which we're competing. We want to be one of the best institutions in the country. We can't disincentivize highly qualified faculty from coming here with those kinds of issues.

We have made progress; I understand we're making enormous progress related to the residence requirement. And quite frankly, one of the best things we get to do is to steal people from -- not too many from Penn -- but to steal people from these institutions who say, "I'm ready to make a move, I don't want to move my family, but I can get an opportunity to come and work at UMDNJ." If we steal their stars, that raises our boat, trust me. And so I think that there are some things that are currently being looked at that further exacerbate the issues that we're having purely because of the economics, in terms of being able to keep and reward faculty.

And I think that-- Back to Dr. Owen's point about reputation: There is all of these issues about quality and that sort of thing. But this is the stuff that kills you, it really does, to have our faculty to begin to go on

the national scene and say, “We’re losing \$140,000 in pension; we’re being told we can’t live out of state anymore; higher education isn’t valued in the State of New Jersey.” Those are not messages we want-- Those are not messages, quite frankly, that are going to facilitate you accomplishing what your goals are related to developing the life sciences in this state -- it’s just not.

ASSEMBLYWOMAN LAMPITT: Any other further questions?

Thank you very much, both of you, for spending time with us and sharing your candid responses. We appreciate it very much.

DR. OWEN: Thank you, folks.

ASSEMBLYWOMAN LAMPITT: The next panel is Dr. Scotto, who we spent the morning with; Dr. David Perlin, who we spent the morning with as well; and Vincent Smeraglia.

Thank you.

KATHLEEN W. SCOTTO, Ph.D.: Good afternoon.

I am Dr. Kathleen Scotto; I am the Vice President of Research at UMDNJ; the Interim Dean of the Graduate School of Biomedical Sciences; and as you now know, I have a research lab here at the Cancer Institute and I’m a cancer researcher.

Before I begin my testimony, I just would like to say one thing in response to one of the comments that was made in the earlier panel, and that is that Rutgers would have beat North Carolina last week if it was not for the fact that the sun was in their eyes. I say that on behalf of my colleagues at Rutgers. (laughter) And I think that pretty much covers everything we’re going to say today.

So we are clearly in an increasingly competitive global environment and we have very limiting resources. The life sciences entities around the world are facing very complex challenges. So obviously it's not just us, they have challenges in the development and commercialization of new healthcare, food production, environmental protection, biodefense products, services, etc.

Having said that, I really do believe-- And as you know, from talking to you this morning, I came to New Jersey only about six years ago. I was in New York and I was in Pennsylvania. And I came to New Jersey really for one reason: I really do believe that New Jersey is in a position to be a powerhouse in the life sciences. And that's what attracted me here. I've always worked with the pharmaceutical industry in the other positions I've had, and I wanted to come here because I really thought it would be easier to do it here than anywhere else.

We have a vast life sciences industry -- that is a huge asset. We have world-renowned research universities with expertise in education and discovery in the life sciences, and -- as you heard from the previous panel -- those universities are in jeopardy. We also have colleges and universities with great strengths in fields that support the life sciences -- in the business, in economics, and law, in technology -- and these are required to form the platform for the life sciences industry, for training and for really deploying the deep knowledge-based workforce that we've been talking about.

So as you know, UMDNJ is the largest public academic health center in the nation. So I will focus what I'm talking about today on the biomedical sciences specifically, but a lot of what I'm saying, I think, applies across all of the life sciences.

And I'd really like to focus on two questions: How does biomedical research, specifically research carried out in an academic environment, positively impact the State's economy? Because I think that's something that, in general, people don't think about very often. Because we think about the pharmaceutical industry and the biotech industry having a positive impact on the economy, but I don't think we think as much about the academic biomedical industry.

And what can we as a State do to enhance our life sciences industry, and our position in New Jersey as what we really could be -- a world leader in this area?

So first: the impact of biomedical research on the economy -- and it's multilayered. I'll start with what we consider most often, and that's health and quality of life. So obviously the impact of the life sciences enterprise on public health is very well known. We've reduced mortality in cancer and heart disease in a number of ways. And you heard from the previous panel the impact that has economically. But without biomedical research, there would be no new treatments. There would be no new interventions. It all comes from research, and I think what is very important to understand is the most recent estimate, which was a couple of years ago, is that 60 percent of all basic biomedical research occurs in academic environments, not in industry. And this percentage is getting higher as industry is facing their own financial challenges, and is looking more and more to the academic world to feed their pipelines with new ideas and new products.

And this research forms the basis for the development of new interventions and treatments by the pharmaceutical industry, the biotech industry, the medical device industry, etc.

So as we talked about this morning, these new treatments are then tested in clinical trials prior to commercialization, and this is another step where universities, specifically academic health centers like UMDNJ, play a major role. Right now UMDNJ has 500 active clinical trials. So those are trials where we're actually looking at different treatments, different interventions, in human subjects. Many of these are supported by Federal grants, but most of them are supported by industry sponsors. So we've worked very hard with our pharmaceutical and biotech industry to take the findings that we have, in many case, brought to them that they have developed into a drug or an intervention, and now we are taking them back to look at how successful those new potential drugs or interventions are.

We're testing new treatments for diseases ranging from cancer to heart disease; you'll hear a little bit about infectious disease from Dr. Perlin in a minute; neurological disorders. We just opened a Child Health Institute. Clearly we have the gamut in terms of the diseases that we're looking at.

We're allies in new medical devices, new prevention regimens, and we're going out to the community to evaluate the impact of lifestyle on disease, the comparative effectiveness of different treatments, different interventions. All of these things you've heard about, certainly, during the time of the stimulus package.

So the results of these studies are part of what then goes back to determine whether novel treatments and interventions should be commercialized. And we are very often involved in working with industry as they move towards commercialization of their products. And you'll hear a lot about that.

And in recognition of the importance of a strong clinical research infrastructure -- and I think this is something that was spoken about on the previous panel -- is how do we respond to industry? How do we work with industry? And that became very clear a few years ago when we had a number of workshops with industry partners, and with some of the other universities, and with the community, and said, "What do you need?" We're not going to decide what you need and then 10 years later knock on your door and hand it to you and find out, oops, you didn't need it -- which is traditionally the way academics has worked. I mean, let's be honest. That is traditionally the way academics has worked. Let's find out from day one what you need and let's bring it to you. And one of the strong needs, and one of the needs that President Owen recognized when he came, was to build a very strong clinical research infrastructure.

And we talked a little bit before about one phone call. At UMDNJ, we're across the entire state. We have a huge clinical research infrastructure. On every single campus we have multiple clinical research centers. Some of them are focused specifically on things like childhood disease; we have one in dentistry; we have one in pediatrics; we have one in environmental health. But there was not one way that you could call a single person and get to any of those. We recognized that, industry brought

that to us as a problem, and we have now fixed that by developing our own academic clinical research organization.

So that's just one example of how universities -- and all of our universities try to do this -- is how we do respond to industry. We need to get together from day one and find out what our needs are on both sides and how to respond to those.

So in addition to supporting industry in the state, obviously biomedical research leads to improvements in health care. And I'll just add one more statistic to what Dr. Owen said, and this was from an article called "The Value of Health and Longevity" in the *Journal of Political Economy*. It was in 2006. And this is a quote: "Reducing cancer deaths," so we're only talking about cancer deaths, "by just 1 percent would provide a \$500 billion benefit to the economy in productivity gains and local healthcare costs." That was the U.S. economy.

So when you think about it in those terms, and you realize that universities do, probably right now, a lot more than 60 percent of the basic biomedical research, you can see what a great impact it has on the State.

So another way that research universities support New Jersey's economy is by bringing new money into the State, and that's in the form of Federal grants and from private agencies. So just to give you an example: Last year alone, the top New Jersey research universities brought somewhere around \$250 million in research funding just from the National Institutes of Health. So the NIH is the largest funder of biomedical research in the country. So only one Federal agency, the top four universities brought in \$250 million. So this is money that has come into the state that would not have come into the state otherwise.

So NIH estimates that every dollar in Federal research spending generates about \$2.20 in total economic activity within the state. And on the average each grant supports seven jobs. So just to give you an idea: UMDNJ alone has, right now, over 300 NIH grants -- so you can do the math in terms of the jobs -- and received about \$145 million in NIH support last year. And we're just one of the universities in New Jersey. So this is a real way that the universities can bring support into the state.

And obviously from what we heard from the earlier panel, the other thing that we bring to the state is prestige, and this is very, very important. And our faculty -- our research, our education faculty, our clinical faculty -- these folks are really critical to nucleate the life sciences cluster in the state. And if you look at any other successful life sciences cluster in any other state in the country, they all nucleate around powerful research universities. And I think that's a very important point to make.

Just as one very small example of some of our successes: About three or four years ago the NIH developed a new funding program, and it was called the Director's New Innovator Award program. And this was established specifically to support unusually creative new investigators. So really bring in the people, the young people, who've got these really fantastic ideas and are going to be the stars of the future. These are all peer reviewed; they only give out a handful of these grants across the country -- I think it's somewhere around 20 a year. In the past two years, New Jersey has received five. We can do better, but five is not bad. We had two at Princeton, two at UMDNJ, one at Rutgers. So this is the kind of recognition -- even our young people, even our young faculty who are just

starting out -- are getting at the Federal level. And again, just one very small example of the kind of recognition our faculty get.

So in addition to feeding the industry pipeline by licensing their new discoveries, which you'll hear more about from Vince and some of our universities colleagues, New Jersey universities' research has also been successfully leveraged into spin-off companies. We actually have a number of companies that our faculty have begun from work they have done within the university, and then they have spun out their, you know, incubators in New Brunswick and up in Newark, and they're all over the state. And some of them are doing quite well. And you'll hear more about those from Vince Smeraglia.

But there are things that are still lacking, and I think these are some of the things that the Task Force wants to hear about. And many of these things are lacking at a national level, so it's not just New Jersey. But there are states that do it better than we do it. And what's really lacking are specific strategies -- and we mentioned this before -- to link the academic and industry partners to assure a seamless transition of basic research to the biomedical development efforts. And you heard a little bit about this, this morning, when Bob DiPaolo was talking about the Cancer Institute. And if you remember that one slide -- here are the basic science discoveries; here's academics; here's the community and health care -- and industry is in the middle and how do we really seamlessly link those? And there are a number of ways that we can probably do it better than we do it now.

We have a statewide network of university research campuses, affiliate hospitals, healthcare entities, and we have the leaders in the pharmaceutical industry. And, really, we are poised, as a state, to develop a

model that meets and surpasses in some ways what has happened in other states. Which, when you talk about branding -- I think you'll hear it later from Don Sebastian from NJIT -- how some of the statistics from other states may not be so much better than what we have here. We just really need to figure out how to coordinate what we do and present it in the best possible and most accurate way.

So how do we accomplish this? I think we can begin by learning from the successes and the failures in other states, and there have been failures. And what is clear -- and I mentioned this before -- is that in the states with successful life sciences clusters, there's recognition that these clusters must include renowned research universities -- there's no question. They need highly regarded teaching hospitals, strong technology, university spin-out companies, and other start-ups, all interacting together in a network to attract and retain the larger pharmaceutical companies. This is what the larger pharmaceutical companies are looking for. Can we educate their workforce? Can we work with them to move their products and their needs forward?

And underpinning all of this interconnected activity is an evolving need for a support network -- and I think that's something else that, as a state, we can do better -- that encompasses entrepreneurs; venture capitalists; angel investors who have money, have interest in investing, don't know where to look; as well as providers of some of the professional services that certainly our university start-up companies or small biotechnology companies don't always have access to.

So I'll give you some concrete suggestions, and I'm happy to talk more about these later on, if you'd like.

We need a New Jersey State comprehensive economic development strategy -- a real written document. We recently tried to apply for one of the challenge grants, and this was a combined NIH-NFS challenge grant, and we were not able to because we lacked that document. And most states now have these kinds of documents and these-- And while I'm not talking about the document per se, I'm talking about the fact that it must target the development and retention of the life sciences and pharmaceutical initiative as critical to the future of the economic health of this state. It really needs to spell it out, and that is one first step to saying, "We, as New Jersey, recognize the importance of this and we're committed to it." There are a number of other states that have this.

An article just came out a few months ago about Cleveland. So what Cleveland did is, they just named their corridor of-- I think it's biomedical sciences and technology. And this corridor encompasses the pharmaceutical industry. I haven't been to Cleveland recently, so I can't tell you exactly where it is -- it's Euclid, it's somewhere. And it's the pharmaceutical industry. It's Case Western, it's Cleveland Clinic. And they've incorporated this, and are proud of this, and talk about and work with this group of life sciences cluster. They've developed something called the Frontier initiative where they actually fund members of this cluster. They bring technology, they bring companies, they help companies come into these kinds of clusters and corridors. And this is happening in a number of places around the state.

Another recommendation: Establish a New Jersey center for entrepreneurship and innovation. Many of the universities have courses in this, but what some states have done is really developed statewide centers --

and these tend to be public-private partnership so it would involve industry, involve the State, involve the universities -- that would establish and disseminate best practices in technology transfer. I mean, that is the major focus of some of these because, as you heard earlier and you'll hear again, one of the big things that we deal with is how to do transfer technology. How do you deal with (indiscernible) in one company and another company at the same time? Sometimes the issues are between different industries, sometimes the issues are between industry and academics. How do we develop a system to more facilely translate what we're doing in academics into the industry, back and forth, and all protect what needs to be protected as we do that?

We can tap a research university for the source of the intellectual capital. We can establish curriculum in these areas, and offer services especially to new companies coming into the state and start-up companies.

The third recommendation is: Coordinate efforts to match entrepreneurs with investors. So there's something in Delaware which was started recently, and I have a friend who knows a lot about this so she was telling me about it, and it's called First Science Innovation (*sic*) initiative. And what that is, it's a nonprofit, a privately operated group that brings together angel investors, venture capitalists, and matches them with entrepreneurs around the state, including entrepreneurs within the university setting. So that's another-- I'm just throwing out these ideas of things we can think about moving forward. And this could also provide a form for key stakeholders in academics, industry, and the State to discuss and facilitate, really, what we need for truly successful public-private

partnerships. Identifying key therapeutic and diagnostic research areas -- this was something that was talked about in the last panel -- where basic and clinical research collaboration is possible. Where does industry see the future in terms of the things they are developing? How do academic institutions work with industry to accomplish that?

Simple things, or they sound simple: promoting master agreements between our State universities and our state industry. It sounds simple, but we just finalized a master agreement that took us years to put together. And every university is doing it independently, and every company is doing it with the universities independently. If we could coordinate this in a better way, I think we could move forward a lot faster.

Here's just another idea, and something we've talked about: some industry collaborating in discovery of new use for legacy drugs, or for drugs that have gone off patent. We've done this; we've done it recently quite successfully. Actually, we worked with a company in Pennsylvania that had a library that they were no longer interested in. It was a compound library; it sat on a shelf. We worked with them through our environmental health group and we applied and received a \$19 million grant to screen these drugs for new uses in terms of intervention and chemical warfare. So there are opportunities out there, but we tend to find them serendipitously. We don't have a coordinated way to find them and they don't have a coordinated way to find us.

Networking, providing infrastructure support for academic-industry collaborations to attract Federal dollars. You know, when we think about bringing in Federal dollars and NIH grants, we tend to think that these happen in academic institutions; but industry has -- especially

industry -- has great opportunities to do this. They very often don't know how. They don't have the wherewithal; they may never have written a grant before. There are ways to be able to collaborate to make this happen.

Develop joint training programs between academics and industry. You heard about one of them this morning; and that was actually a program with my other hat on as Dean of the Graduate School -- is that we develop because there was a need. And the biotech company in the South came to us and said, "There's no training in the state for a molecular pathologist. We need a molecular pathologist." We sat down, we worked through a lot of compliance issues, and what we came up with was a program that is a wonderful program, it's in its first year -- it's beginning its second year -- very successful, and it's collaboratively taught. And the students can choose to go into a lab in the university or go into a lab at the company. And we have great oversight over this, to make sure that this is a true thesis. They all have committee members. But this is something that works; we're doing more of it, other universities are doing it. This is another way that we can work together, really, to develop the workforce that is needed by industry.

And I think we all realize that some of these recommendations come with a big price tag. And we all know what the fiscal situation is now. But I don't think that their importance or our commitment to them should be negatively influenced by that, because we need to do this. And although research limitations are going to affect the speed with which we can do this, we need to start now. We need to commit to what we have to be, and what we have to do to become the New Jersey that we want to be in the future. And then as the resources become available -- and hopefully they will, or we

will help to bring them in -- then we can speed up the path to this. But I really, personally, believe that we really can do this, and we can do it well, if we coordinate it.

So I'd like to end with one thought: So in 2007 a major national benchmarking report on the economic importance of the life sciences industry was commissioned. In referring to the importance of a strong life science enterprise to economic growth and development, they stated, and I'm going to quote this: "The New York-Philadelphia corridor is particularly important, with dominant biopharmaceutical subsectors." New Jersey was not mentioned. So I've lived in New York, I've lived in Philadelphia, and I can tell you: That corridor is New Jersey, and yet we are not being called out as critical to the life sciences industry in this nation. We can change that. We have the industry strength, we have the major research universities, we have the nation's largest public academic health center, we have major science and technology teaching institutions, and, of critical importance, we have the support of the State.

So we have in place all of the life science components needed to grow New Jersey's economy, create the high-paying jobs, and discover new ways to diagnose, treat, and prevent disease. We need to focus these strengths. We have them. We need to enhance them. We need to enhance our dialogue, we need to channel our creativity so that in future reports it's going to be New Jersey, not the New York-Philadelphia corridor, that is called out as being the life sciences cluster.

Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you very much.

Are you sure you didn't sneak in what your aunt suggested that you do -- go to business school? (laughter) Based upon those economic development suggestions, I think you might have, Dr. Scotto.

DR. SCOTTO: Well, I'm looking for a tuition reimbursement so that I -- in one of our sister schools. Maybe they'll--

ASSEMBLYWOMAN LAMPITT: Dr. Perlin, or Vince?

DR. SCOTTO: Actually Dr. Smeraglia, if he could-- Mr. Smeraglia, if he could go first.

ASSEMBLYWOMAN LAMPITT: Mr. Smeraglia, okay; go right ahead.

V I N C E N T S M E R A G L I A, E S Q.: Good afternoon, Assemblywoman Lampitt and members of the Task Force.

My name is Vince Smeraglia, and I'm the Director of the Office of Patents and Licensing. I want to thank you for giving us the opportunity to testify today.

Our mission at the Office of Patents and Licensing is to work closely with research faculty to identify novel research and develop intellectual property around that research, and then create alliances with diagnostic, medical device, biotechnology, and pharmaceutical companies helping to solve critical and medical needs.

As many of you know, universities have a long and distinguished history of discovering important biomedical inventions. University patenting and licensing has fostered commercialization of new technology that impacts the lives of millions of Americans. While it would be impossible to list all of those inventions, a few examples might suffice.

The cancer drug cisplatin was developed at Michigan State University. The blood thinner warfarin, which has been used for many decades, came from the University of Wisconsin. The process for making the blockbuster breast cancer drug Taxol came from Florida State University. These are a couple of examples that demonstrate a strong national infrastructure for tech transfer across universities around the country.

A national survey reflects the impact of this on economic activity. There have been over 2,000 new companies that have been formed based on the licensing of an invention from a university. Approximately \$30 billion of economic activity that supports a quarter-million jobs can be attributed to the commercialization of university inventions. And most to the point, there are over 1,000 products on the market today that are based on university research.

Technologies license for academia have been instrumental in spawning new industries, improving productivity, and creating new companies and therefore new jobs.

UMDNJ itself has a long history of innovation that's led to company formation and products that help solve medical problems. For example: Dr. James Millonig of the Robert Wood Johnson Medical School discovered a linkage between a gene called ENGRAILED 2 and the onset of autism, a disorder with a high incidence rate here in the state. Our office worked with Dr. Millonig to patent his invention and license it to IntegraGen, a diagnostic company that's launching an autism test. Autism is generally very difficult to identify in young children, and this diagnostic

test holds the promise of early detection which, in turn, could lead to medical interventions.

Recently, Dr. Jeff Kaplan of our New Jersey Dental School discovered an enzyme called dispersin B, which he realized could be critically useful in the breakup of bacterial biofilms which occur in surgery when medical implants are surgically implanted into patients. This invention was recently honored as one of the top five inventions by the National Institutes of Health, and we've licensed it to a company that's coating dispersin B sort of like an enzymatic pixie dust on medical devices that prevents infections when they're implanted.

At our New Jersey Medical School PHRI Center, a breakthrough tuberculosis test has been developed by Dr. Marila Gennaro which identifies TB faster and more efficiently than anything presently on the market. The technology has been approved by the USFDA, European regulatory bodies, and in China; and the technology's already making a difference in the lives of those with tuberculosis.

UMD discoveries have also led to considerable economic development here in the State of New Jersey by being a platform for new company formation. PTC Therapeutics, headquartered in South Plainfield, has formed around the innovations of the Robert Wood lab of Stuart Peltz. PTC has attracted venture capital from California, other places on the West Coast, and European venture capital firms; and now has two drugs in late-stage clinical trials: one for cystic fibrosis and one for Duchenne's muscular dystrophy. The firm employs over 120 people here in the state. These are solid, high-paying jobs that would not be possible without a University intervention that occurred several years ago.

Innovative biomedical research has also led to alliances with large pharmaceutical companies here in the state. A technology in the field of collagen biomaterials was licensed to a small firm called ColBar as its platform. After additional development, Johnson & Johnson company was so impressed with this invention that they purchased the entire company and they sell the product around the world.

We've also licensed our Molecular Beacons technology to the Becton, Dickinson and Company which is headquartered here in Franklin Lakes, New Jersey.

These are the types of high-value alliances that demonstrate the synergies between the University and local life science companies.

Another set of collaborations are those that occur between various New Jersey State universities. One of them occurred right here at CINJ. A clinician here, Jim Goydos, was collaborating with a professor at Rutgers in the biology department named Suzie Chen when they discovered a new use for a drug called riluzole. Dr. Chen and Dr. Goydos realized that this drug might have applications in skin cancer, and the NIH funded a clinical trial that's now showing, in early stages, that the drug can help with very late-stage skin cancer.

Secondly: In another collaboration with our friends at Rutgers, Leroy Liu, who's in our Pharmacology department, worked with a chemist at Rutgers named Ed LaVoie to develop a new cancer drug, licensed to a large pharmaceutical company in Boston -- Genzyme Corporation -- that is now taking the drug into later-stage clinical trials.

We've had some wonderful interactions between engineers at NJIT and physicians at our New Jersey Medical School improving life-

saving incubators. And we also have joint inventions with Princeton University and the Stevens Institute of Technology.

In all these examples, the joint University efforts are much greater than the sum of its parts. In further expanding health science activity in the state, and with particular growth in University start-up formation, I want to highlight the important State assistance of the New Jersey Economic Development Authority and their incubator efforts. Several of our growing University start-up companies are housed at EDA facilities where they receive a great deal of practical support and encouragement.

I also want to appreciate the past assistance of the New Jersey Commission on Science and Technology. NJCST's past seed research support has resulted in some of our companies receiving follow-on venture capital and large Federal grants to move the companies forward, again creating additional jobs. It's proven both in New Jersey and around the country that a small amount of State research investment in academia can leverage a large amount of future investment from others.

Finally, I'd like to suggest the Task Force should consider reviewing how other states, such as Pennsylvania, Michigan, and Massachusetts, created a large number of mechanisms to aggressively promote health science research. Some of these novel state approaches include setting up state venture funds to invest in start-up companies; having the state organize technology conferences, bringing together local pharma and biotech industry to meet with academic leaders. This is the sort of approach that doesn't cost a lot of money, but the state organizing such an effort can make a big difference. And also, enhancing research

efforts by supporting targeted studies in therapeutic areas that our universities are particularly strong in.

New Jersey needs to bolster its commitment to health sciences or we risk falling behind other states that are already making substantial investments.

I'd like to thank the Task Force for organizing this hearing on the important connection between university health sciences, research, and economic development in our state.

I look forward to answering any questions.

ASSEMBLYWOMAN LAMPITT: Thank you, Mr. Smeraglia.

You didn't pass out your testimony, and I was wondering whether or not you could e-mail it to us.

MR. SMERAGLIA: Sure.

ASSEMBLYWOMAN LAMPITT: You highlighted some of the wonderful, great accomplishments in the State of New Jersey, and certainly we're all very willing to speak about them. And I think if you share them with us, it's right at our fingertips to be able to do just so.

So thank you very much.

MR. SMERAGLIA: I'd be happy to e-mail.

ASSEMBLYWOMAN LAMPITT: Dr. Perlin

DAVID S. PERLIN, Ph.D.: Madam Chair and members of the Assembly Task Force, thank you for the opportunity to address you this afternoon.

My name is David Perlin. Like Dr. Scotto, I'm a scientist, I run a laboratory, and I'm a faculty administrator. I'm also the Executive

Director of the Public Health Research Institute -- that's PHRI -- and the UMDNJ Regional Biocontainment Laboratory.

The PHRI is a 69-year-old biomedical research institute that specializes in infectious diseases. As an institution, we were formed in 1941 by Fiorello LaGuardia and spent the better part of 60 years in New York City.

We have 21 laboratories with approximately 150 full/part-time employees. And the PHRI has funding from the National Institutes of Health -- we have about 40 grants and subcontracts. We have another 20 or so contracts from private foundations, pharma, and biotech. And we have income from intellectual property that, as Vincent Smeraglia mentioned -- Molecular Beacons -- that program in itself has brought in close to \$30 million.

In 2002, PHRI in New York City was faced with the opportunity to move to New Jersey. And, in fact, we moved from New York City to Science Park to be the lead tenant at the International Center for Public Health. This is in Newark Science Park. That decision was really based on our need for resources and the ability to grow and to be able to build our organization in a dynamic way.

In 2006, after being in New Jersey for about four years, PHRI was acquired by UMDNJ, and we're now sort of proudly a center within New Jersey Medical School.

PHRI's decision to relocate to the Newark campus was really based on the State of New Jersey's commitment to build a first-class resource so that we could continue our infectious disease research. And I should mention that that infectious disease research involves work on

tuberculosis; HIV; hospital, community-acquired pathogens; flu; agents of bioterrorism. So we really did need specialized facilities. In talking with the New Jersey officials, there was commitment to build this facility and to work with us to help design that facility so it truly met our needs as an organization.

Furthermore, there was a commitment from some of our neighboring institutions like NJIT, Science Park, and NJEDA to help attract private sector small companies -- biotech companies -- to an incubator that would be built. And that was important to us, because when you work in infectious diseases you're interfacing between basic science and the organizations -- the commercial sector companies -- that then take those inventions and then turn them into products. So working with small companies, with medium- and large-sized pharma, is very important to our overall mission.

Now eight years later -- 2010 -- the investment has really paid off. The Newark campus has, indeed, become a center of excellence for infectious disease research, and is really widely known as one of the best programs for doing tuberculosis research in the world. In fact, in the past 10 years, the PHRI program has attracted somewhere in the neighborhood of about \$70 million for doing TB research.

Now, PHRI's yearly revenue has grown from just over \$11 million in 2006 to now over \$15 million, and it will be more next year. This has enabled us to expand our programs. We can be competitive, and as Dr. Rodgers was talking about, trying to attract high-quality faculty members. We've recruited in the last three years -- two-and-a-half years, to be precise -- four new faculty members: one from Mount Sinai, one from

Cornell in New York City, one from Duke, and one from Georgetown. And we were competing with the top universities in the U.S for these individuals. And we feel we can be competitive -- and we felt we could be competitive because we were able to create a center of excellence for these individuals to do their research. We can provide the funds but, beyond that, we have to create the environment for them to be successful. And that's what we have, and that's what we've created in our Newark program.

In addition to the work at PHRI, we were fortunate enough to, early on when we came to New Jersey, partner with UMDNJ -- and that was before we were part of the University -- on a large grant -- a \$25 million grant -- to build a regional biocontainment laboratory to be able to do advanced work in the biodefense area. And, in fact, our program in biodefense is one of the largest in the U.S., and one of the most dynamic, and one of the least recognized, I think, by certainly folks within New Jersey -- well-known within the scientific community, but not beyond. It's really a first-rate program and it centers around resources and facilities.

The International Center for Public Health was built with high-level containment laboratories so we could work safely with agents like tuberculosis, anthrax, plague, and other agents like that. Without that facility, we couldn't do this work safely and reliably, and so we're really on the cutting edge and have published a great deal of work on new vaccines, therapeutics, and diagnostics in this arena. And it's something that's going to take us forward. And the regional biocontainment laboratory, which is one of 13 national designated centers by the National Institute of Health, is really our step forward to be able to continue to advance this work and to

keep biodefense at a place where we can actually have a strong impact in preparedness; and it keeps New Jersey out in front.

And this is really a critical point, because what we're talking about is building excellence. That's what we need -- we need to have excellence in terms of our faculty, in terms of innovation of research, and in terms of resources.

Now, PHRI's specialty is in the translation of laboratory discovery into practical applications. You heard a lot about that this morning from Dr. Scotto. That's really a key, I think, to what many of the New Jersey institutions are doing, and certainly within UMDNJ -- taking basic science, and then getting it to the patient in a way that can benefit the patient, and then understanding what's going on, and going back to the laboratory for refinement -- is really what it's all about.

And so as we interface between the private and public interface -- because we need companies to take these discoveries and commercialize them. As a scientist I know all about molecular pathways, I know a lot about the pathogens that we study, I know a lot about the human host. But it's not-- My expertise is not in developing drugs, or in developing diagnostics, or in developing vaccines. There we need professionals -- those are pharmaceutical companies, biotechs, and others -- who understand how to do this and can make this happen. So we need to partner with those companies; and to partner with them, we need to bring them close to us and we need them to feel comfortable to work with us. And so we need true partnerships. And that's one of the things that we've been promoting for some time.

So early on, when we came to New Jersey, I agreed to sit on a number of panels. I've worked with NJEDA; I've worked on the Newark Innovation Zone. And I have worked with New Jersey Commerce, Economic Growth and Tourism, through the International Trade and Protocol commission, to be able to identify companies that would have an interest in our area of infectious diseases; and how we might help them and convince them that relocating to New Jersey is really a good thing for them, and certainly a good thing for us.

And so, typically, what we would do is-- Companies would be identified, we'd be contacted, we'd tour them through our facilities, we would talk about the science that we do. We'd talk about the excellence that was present on campus, and then we'd talk about partnerships that we had with the commercial sector and how it really is this academic public-private partnerships that will advance the companies.

In addition, we talk about specialized resources and we talk about leveraging infrastructure. So we talk about our regional biocontainment laboratory, how we have advanced animal facilities; that if a company has a new tuberculosis drug that, in fact, they can do the work at our facility, and we'll partner with them and they don't have to invest \$10 million in new facilities; that they can work with us and then they can obtain this critical information they need to go to FDA and advance their products.

So in this way we've been able to attract companies. In the last two years we've been quite instrumental in bringing a small company -- a clinical, diagnostic company, CGC Genetics -- from Portugal. And I think really it was because of our efforts that they were most comfortable. And

then also Daewoong Pharmaceutical Company from Korea, where I visited them, they came to see us, and they've relocated part of their operation here. Because I think they felt a comfort level with the type of academic environment that we have available, and the resources. And they just felt that it's a good opportunity for them to expand into the U.S.

So in my view, what are the companies looking for? They're looking for superior facilities and academic excellence. They want an environment that's creative and successful, and they want to be able to leverage existing infrastructure. One really does not work without the other. You can have excellence, but you need the facilities. You can have facilities, but if you don't have the excellence then you won't be able to attract these companies.

So we've really tried, certainly, in our small niche to create a center of excellence with outstanding resources, which we really believe is a magnet to bring companies to Newark.

Now, in terms of challenges: The most significant challenge is in maintaining that excellence. Our faculty members are constantly being barraged by more prominent institutions in the local area, in New York City, that have resources to throw at our faculty members. It's not just about money. The way we've been able to retain our faculty is by convincing them that by staying and keeping the excellence that we've created, that they ultimately will be more successful. That's what we need to do. It does take additional resources, and we are constantly fending off competitors. But that's okay; that's the name of the business. So we need to continue to be competitive; we need to continue to be aggressive at

retaining and attracting new faculty members; and then, ultimately, we have to do strategic investment.

We can't cover all our bases, but through strategic investment in infrastructure, resources, specialized equipment, and individuals who bring special areas to the table, I think we can attract business, the commercial sector; we can attract large pharma, medium-size pharma; and certainly biotech to New Jersey and keep them here.

Thank you very much.

ASSEMBLYWOMAN LAMPITT: Oh, no, thank you. Thank you, Dr. Perlin, and thank you to all the panelists.

I don't know if anybody has questions -- I just have a short one or two. Dr. Perlin, were you with this organization -- the Public Health Research Institute -- back in 2002 when it moved from New York?

DR. PERLIN: Yes, I've been there for 25 years.

ASSEMBLYWOMAN LAMPITT: Okay. So my quick question is this -- because Dr. Owen made a comment about researching and serving the bioresearch, the pharma companies, about what do they need, what are they looking for. When you decided to make that move from New York to New Jersey, did you do your same research and say, or call the institutions of higher learning here and say, "What's in your pipeline? What are you researching? Who are you educating, and what are you educating them in?" to ensure the fact that the pipeline of the educated workforce was going to continue here?

DR. PERLIN: We absolutely did that. And we were looking-- We were renting space in New York City, and when we decided that it was time to move, we looked at institutions in New York City, we looked at

institutions in Connecticut, and we looked here. And the reason we came here was first and foremost because of UMDNJ. We recognized that there was opportunity, there was a commitment to us.

ASSEMBLYWOMAN LAMPITT: That wasn't a softball question, Doctor. (laughter). I didn't know this.

DR. PERLIN: It's beyond that.

ASSEMBLYWOMAN LAMPITT: He's smiling back there.

DR. PERLIN: But beyond that, it really had to do with access to decision makers and priorities. In New York City we never felt like we were a high priority. We were always competing with the financial sector and commitments from New York EDA in that realm, and we were always being told, "We can't quite do enough for you." And we didn't really believe there was a strong commitment to the life sciences. We had strong institutions in New York City, but as a state, we didn't believe that there was a strong commitment. There was a much stronger commitment here, and we had access to the decision makers. And so first and foremost that was really critical. And the State delivered in a timely fashion, and that's the other point. That when we needed to make a decision and a move, New Jersey was ready -- Connecticut wasn't, New York City wasn't -- and that was a big factor.

ASSEMBLYWOMAN LAMPITT: Thank you.

And I guess my only other question, to Dr. Scotto, would be: You said it's one phone call, and Dr. Owen also made the comment about one phone call. Did you develop some sort of concierge where you're making -- you're allowing the pharma industry to make one phone call to you, they know exactly who to call; and, likewise, do you know who to call,

vice versus, vis-à-vis the higher education so that you're making that one phone call and getting *the* answer?

Dr. SCOTTO: So the answer to the first question is yes -- we now have web sites, we have literature, we go to pharma all the time and they come to us. And there is one number that you can call that will-- Remember, we have three major campuses and hospital affiliates, and partners on all of those campuses and our own hospital. And someone can call into a single number and say, "We're interested in doing a test on a new drug for diabetes," and we can find, within the University, find the faculty, find them on different campuses. And one advantage to pharma is that very often, as you know -- well, all the time, pretty much -- they have to do multiple sites when they do their clinical trials, so we can offer them, potentially, three different sites because we have three medical schools at which these trials can be carried out. So yes, there is now a single number.

It's interesting -- it doesn't happen in the other direction. What I finally realized -- as we were gathering all this and thinking, "Yes, we're not working well enough with pharma and here's why: They don't know who to call" -- we don't know who to call on the other end. And we very often had very, very good meetings and very positive meetings with folks from pharma. And then the rubber hits the road, they're not the right people. And they're not even sure who the right people are. You deal with some of these huge companies where there are 200 subsidiaries, and you need subsidiary 27 and you're dealing with somebody (indiscernible). So I would say that, at least in our experience, that we're-- I mean, there's always somebody we can call. But it's not one-stop shopping when we try

to do the opposite with the pharmaceutical industry. And we've been working with different companies to try to locate that one person.

ASSEMBLYWOMAN LAMPITT: Thank you.

We have questions by Assemblyman Chivukula.

ASSEMBLYMAN CHIVUKULA: I just have a quick question on the venture capital. A lot of the venture capitalists come from New Jersey, but what I hear is that they tend to invest outside of the state. How do we reverse that trend?

MR. SMERAGLIA: One of the issues is -- at least the venture capitalists we spoke to here in New Jersey, in the Princeton area and others -- want to do large follow-on investments when somebody else has put in seed money. And so you'll typically have VCs in New York and Philadelphia do original -- the highest-risk investments, and then the New Jersey VCs will sort of pile on and follow on that investment.

So one of the faults with our state is a lack of a large, comprehensive sort of seed venture capital network. We do have AngelVine and some others who are trying this area.

The other, frankly, is some states, in order to push themselves forward, have set up state venture capital funds. In Connecticut there's a large and growing venture capital fund that the state of Connecticut has set up that has actually, frankly, made a tremendous amount of money, because they invested in university spin-outs, other spin-outs in their state -- usually focusing on the things that they do well in their state. So here in New Jersey, if we had an analogous approach, there'd be investment in pharmaceuticals, in telecom, in other areas where we're strong. And that, in my view, over the long run, would pay for itself many times over. It would

also attract this follow-on investment I'm talking about with VCs in New Jersey right now. If they saw commitments from someone else on a seed level, they would follow-on with additional investment.

ASSEMBLYMAN CHIVUKULA: Yes, we do have the Edison Innovation Funds. Has that been effective?

MR. SMERAGLIA: Frankly, Edison is afraid to invest in biotechnology in high-risk areas. They tend to do things that are quick to market and, as you know, when it comes to medical diagnostics or therapeutics, it takes 5 or 10 years. And they haven't been as aggressive in this area.

ASSEMBLYWOMAN LAMPITT: Assemblyman Rible.

ASSEMBLYMAN RIBLE: Thank you.

Dr. Scotto, if you could-- We talk a lot about resources. Is there anything that we can do legislatively, or that the State has been doing wrong, that is preventing resources coming in here -- with regulatory issues? Is there anything that's stopping people, saying, "You know what? We're not spending money over there. Investments in New Jersey--"

DR. SCOTTO: Well, you know, obviously the best resource is money. But there are some other opportunities, I think. I mean, for example: One of the things that we came across recently is a document that truly commits the State of New Jersey to the life sciences industry for economic development, that makes that type of true commitment. Because while that is not direct money in our hand, that gives us the opportunity to apply for outside money, given that we have this commitment. I mean, developing these life science clusters, things like that -- I'm not sure I'm the

best one to answer how to do it legislatively. I mean, we've been really trying to think about this a lot, of what we can do.

I mean, some of the issues that we have dealt with in the past -- and I'm not sure if there are legislative changes to this -- are, for example-- And this is an issue that's getting much tougher nationally and that a lot of states are dealing with. But on the one hand, you want to work with industry and the state. And on the other hand, working with industry can be very, very difficult because the relationships, as you know, between academic and the industry are under microscopes. And to some extent they should be. We need that level of transparency. But very often what happens is we have barriers to those interactions in terms of compliance regulations and concerns about conflict of interest. We all have very strong conflict of interest concerns. We have conflict of interest committees.

But sometimes the concerns far outweigh the reality of the issues. And I noticed this when I first came to the state, I have to be honest, which was five years ago or so. And I was asked to give a talk at Johnson & Johnson. It was their lunchtime-- I'm a basic scientist, so I had been doing some work that they were interested in. And it became a big issue because I wasn't allowed to eat lunch there. And they said I could eat lunch there but I had to pay them \$10. So you know how embarrassing it is to go into a pharmaceutical company in this state and try to figure out how to get a receipt for \$10? I mean, these are the kind of things that seem to be very trivial, but they set up a culture that makes it very difficult.

And Bob DiPaola was talking this morning about developing a safe haven. I think that's one of the things the State can do -- a safe harbor -- is develop that kind of safe harbor. On the one hand, we can set up our

own meetings, and we know pretty much who to call in industry and we can get a meeting set up and symposia. But by having the State behind those kinds of interactions, it puts, I think, both the pharmaceutical and biotech industry, as well as academics, in a much more comfortable zone in which to have these kinds of discussions. So that's something that isn't even, I would guess, legislative.

But I would say, for small amounts of money some of the things that you've heard today could be done. If there were investments of, say for example, something like -- what states do is, they'll do small matching funds for Federal money or for money that comes from outside of the state. Not total match, maybe 10 percent to incentivize faculty to get grants from outside the state -- from NIH, from NSF, from DoD, from wherever they're getting their grants -- and just give a small matching to the university to do those sort of things. If you look at the actual dollar amounts of what comes in from out of the state, you can do the calculations as to whether that's really affordable and set up those kind of things.

I know that there's-- What the Commission on Science and Technology did was very, very important to the universities. I will speak personally, but I think there are a lot of people in this room who will back me up on this -- I think it's really a shame that we don't have that entity or an entity like that. It was very important -- it supported the tech transfer enterprises within the university. And I don't mean completely supported, but it emotionally supported them and put a little bit of money into making that happen. It developed the post-doc programs where our own-- It was a way to keep our students in the state, because it developed programs where we could take our New Jersey students -- and that was a requirement, New

Jersey students -- and put them into New Jersey biotech companies. It was great for the students, it was great for the university, it was great for the biotech companies, it was great for the state.

So I think there are a lot of things that we can do with really minimal resources that could really help move all of this forward. And I'll step back and see if my-- And I'm sure some of the speakers on panel three also have ideas.

MR. SMERAGLIA: I would say something about the leveraging effect. I'll give you an example of a small seed grant from the New Jersey Commission on Science and Technology that came to one of our start-up companies, Snowden Pharmaceuticals. They did some initial research and, basically, with the data from that small seed grant from NJCST, they were awarded a \$9 million DoD contract that would not have happened if CST wasn't there giving a small amount of money at the beginning to do a pilot study -- which led to, basically, a 10-fold leveraging of that small amount of money. So that's something we have to think about.

ASSEMBLYMAN CHIVUKULA: You're right about that. New Jersey Commission on Science and Technology -- for every dollar that the State has invested, we're getting (indiscernible) return. And this is the message I've been bringing out, and we also held a hearing in my Assembly Telecommunications and Utilities Committee to talk about the life sciences -- the importance of life sciences and how New Jersey Commission on Science and Technology has played a role. I mean, we've got to keep saying that, and hopefully somebody will listen.

ASSEMBLYMAN RIBLE: One last comment -- question for Dr. Perlin, and a follow-up.

Chairwoman Lampitt's comments of being brutally honest: As you served on these advisory boards, and you said you're going around the nation, around the country talking, and you say you're from New Jersey, we want you to come. How bad was it?

DR. PERLIN: Well, they're skeptical. I describe our resources, I describe what we're able to do, and they're skeptical. And what we have to do is bring them in. When we bring them in they say, "Wow, you built this? You built this in Newark? This is fantastic." I mean, if any of you have visited the International Center for Public Health, you see it's not only just an outstanding research building, it's a first-class research facility for infectious disease research. And it's one of the reasons that we -- I think we're really one of the leading centers for infectious disease research. And the infrastructure that's been built around it at New Jersey Medical School.

Well, I can talk about this, but people are skeptical about it. And so what we have to do is, we invite people to come visit. And once we do, then we can change their mind. But you're absolutely right: We have to get over this hurdle first, and it does take some convincing.

ASSEMBLYMAN RIBLE: I think one thing that should be helpful for most folks, especially -- not only in the life science industry, but just folks who are looking to manufacture and are actually giving New Jersey a look -- is I think we've had some success with reviewing some of the red tape -- the Red Tape Review Commission that was initiated at the beginning of the year. And I think by initiating that, that that's actually taking New Jersey off No. 50 on the list of businesses for a change, so we've

actually made a budge somewhere, which is good. And I think that is one thing that is going to be very helpful as we keep moving forward. I think we're looking at a more proactive DEP who is saying "We'll give you an answer right away before you get your investors, go through the system;" and a year and a half later say, "No, by the way, you're not getting that permit."

So we are trying in that way, so I think we're trying to get on the right foot where we're going to start, hopefully, luring more people to help your industry.

So again -- I know we're going to have another panel come up -- I do appreciate your hospitality and I appreciate everything you guys did with the labs and everything -- and thank you for educating us here today.

ASSEMBLYWOMAN CASAGRANDE: Just one more question: Along the lines of what Assemblyman Rible had asked -- this is directed to Dr. Perlin who, it seems to me, is actually giving the tours of the facilities and trying to get these companies in New Jersey. And I'm guessing for every CGC Genetics that you get to commit to New Jersey, there's another company or two who does not commit.

So with brutal honesty and great specificity, can you tell us the most common reasons you're given that a company will not commit to coming to Newark?

DR. PERLIN: Well, I should point out that our group is really a promoter; really more or less a catalyst, because we're not specifically responsible for bringing the companies to New Jersey. But we're asked to act in a role where we host the companies, and we display what's available

to them and what the potential is if they come. So we don't always hear the reasons that companies don't come.

But I think often it has to do with other resources that are being made available by other states, and other incentives. And I can't specifically speak to those, but I know that I have often had follow-up conversations with companies about what we could provide to them in terms of access-- We work with almost all the New York City and New Jersey hospitals-- Access to hospitals, access to research, clinical trials, and what the University makes available and how we could make that available to companies. So I do have lots of follow-ups; I don't always know the reason why companies do not relocate. But I know that when they talk to me about what they like, they always say they're impressed with the quality of the people who are there -- the scientists, the clinicians -- and they're also impressed by the facilities. So I think we're starting to make the case, but the other pieces I don't know about.

ASSEMBLYWOMAN CASAGRANDE: I've heard a couple of times what the companies like. Do you get any sense of what they don't like? What's steering them away?

DR. PERLIN: I don't hear-- I think specifically it's, for many of the companies, it's expensive for them to build laboratories, and so-- Each company has a specific need, okay? And so we can leverage our operation to help many of them. But I don't have specific feedback for you, unfortunately. I think the Commission would, on what it was that either moved a company to another state, or they just decided not to relocate entirely.

ASSEMBLYWOMAN CASAGRANDE: Thank you.

DR. SCOTTO: I can just add to that, since Vince and I work a lot with companies and we also meet, as David does, with companies that are considering coming into the state. And one of the things, interestingly, that some of them are looking for are opportunities to do clinical trials. So in that way we met with two companies fairly recently, showed them our facilities, and got them here. So it was another similar example to show us what you can actually do.

But in a couple of cases -- it most often comes down to money, to be honest. They are looking at other states that have tax incentives and more incubator space. And, you know, there are things like that that I think have come up in our conversations -- and I don't know if Vince has more to add to that -- where they have not, specifically, said, "I'm not coming here because--" But they have specifically asked of those opportunities, because they are looking at other places that have those opportunities. If that's any help.

ASSEMBLYWOMAN CASAGRANDE: Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you all very much. We really, truly appreciate it.

We have one more panel. And before we start this panel, I just wanted to let everybody know that we appreciate all of your time, patience, and everything else. This is just a lot to absorb, a lot of questions. But some of the legislators have other commitments. So if somebody leaves, it's not because they're not interested in your information as well. Hopefully you have testimony to be able to share with us. And if you do, we will also share it with them. We're just very pleased for you to be here.

This is a panel of individuals from other institutions of higher education in the State of New Jersey. We have Don Sebastian, Provost and Senior V.P. of Research and Development at NJIT; we have Dipanjan Nag, Executive Director, Office of Technology and Commercialization at Rutgers University; we have Mike Palladino, Ph.D., Dean of School of Science of Monmouth University; and we have Malcolm Kahn, V.P. of Enterprise Development and Licensing, Managing Director of Stevens Innovations at Stevens Institute of Technology. There's a multitude of knowledge sitting here in front of us. We appreciate you being here today.

Gentlemen, I'm not so sure who wants to start, but maybe we can go from my right.

M A L C O L M K A H N: Thank you for the opportunity, Madam Chairwoman and committee -- for the opportunity to speak today. Unfortunately, I didn't get the memo, so I don't have a prepared statement. But I do have many thoughts that I'd like to share with you and some answers, maybe, to the questions you've addressed today.

By way of a little background, I come to this not in the higher education and licensing vain. I've been a serial entrepreneur all my life -- for the past 25 years -- some of those companies being in New Jersey. I may have some comments on your questions of what difficulties -- it is to run an operation in New Jersey.

And so my thoughts on the commercialization side, and small companies, and the effect that we can have on attracting them I think you may find to be worthwhile.

First, by way of a little background also -- Stevens Institute of Technology: We are a private institution, engineering-focused, in Hoboken,

New Jersey. We have about 2,300 undergraduate students and about 3,500 -- 3,600 graduate students. So we kind of flipped this around the other way.

We do a great deal of work and effort in entrepreneurship. And one of our main focuses is to help our researchers, and engineers, and students actually become entrepreneurs. So in addition to minors in entrepreneurship, we actually do help them spawn companies. And one of the big focuses and reasons that I joined Stevens Institute of Technology is to help that happen.

Small companies represent a huge percentage of the employment, as you have already heard from many other places. And we believe that by helping, in a number of ways, these operations to spin out, that jobs are created and economic benefit certainly comes to the State.

To address some of your questions, the STEM -- we are also very engaged in the STEM area. We have trained over 30,000 educators. We have a big STEM program at Stevens Institute of Technology called CIESE. We have trained 30,000 educators in New Jersey and surrounding areas. We have 100,000 a year that are going through our programs on STEM education. We have received, just recently, a \$12.5 million grant from the Federal government for further development of our CIESE programs. We do a lot of education development and train teachers how to teach science and technology from third grade on up through high school. And so it's been a very successful program for us. We have a 2X improvement in performance on our programs through the STEM education, and it has been very successful.

I'd also like to address a couple of thoughts beyond what we're doing educationally. You've heard a lot today about much of the pure biopharma kind of work. I would also like to suggest that you include in this focus medical diagnostics, instrumentation, all of the other areas that touch life sciences. It is not just drug discovery. And I would encourage you to think more broadly than that. We have quite a few programs that are developing technologies in microbial coding, in skin and tissue engineering using nanofibers and scaffolds. We have programs in quite a few areas of optical bacterial identification, and detection of contaminants and other things in liquids that help the pharmaceutical business actually develop a product.

We also are working quite extensively on smart systems for detecting disease states that we are, in cooperation, taking to Africa and helping the African countries in detecting disease states using smart systems because of the lack of doctors. And so we have quite a bit of research actually going on in that area as well.

So I believe that we are at a point of the perfect storm, and it's not a pretty storm. And the perfect storm, in my opinion here, is that, number one, we are late to the game. You heard today many of the states are already well-engaged in promoting these kinds of companies to their state and developments to their state. Moreover, I think other places in the world are even outstripping the United States. I just came back from making a presentation to A*STAR, which is the NSF of Singapore that spends \$4 billion a year in a country that you can drive across in 20 minutes. (laughter) And much of that spending is in the biopharmaceutical area.

I think that we have a state that is a high-cost state. It's recognized as a high-cost state. That doesn't help us get jobs generated here. It doesn't help us attract companies. I think that's a difficult problem to resolve.

The other issue, I believe, is that we can't really rely on State and Federal assistance. There is no money. We understand that. And I think it's important for us to open the way to do some unique things with the resources that we do have. And while I kind of look at the issues from a real, true business perspective -- because I have been a businessman, and I have started a number of companies. And I think that we have a need for speed -- in the infamous words of Tom Cruise. We need to do certain things that we can do now. I think developing the university base -- we've done a fabulous job. You heard some great testimony today on all of the things that the state is capable of, and that's only from a few institutions. There are many others who are contributing as much, in terms of research and development that will ultimately turn into product.

But I think that we have several opportunities here that I'd like for you to give some consideration to. One of the perfect storm issues I didn't mention, that is critical, is we have a consolidating pharmaceutical-biotechnology industry. And there are companies that are buying other companies, and actual companies that are closing facilities and giving away or selling equipment. That is, I believe, a huge loss of opportunity. Opportunity loss is really what I'd like to address.

We have incubators in the state. But what I like to think about is how the legislation could assist. Actual pharmaceutical and biotechnology companies use their facilities as in-house incubators. These

facilities exist. They're tearing them down because they don't want them on their tax roles. They can't afford to keep them. They're getting rid of their equipment. They're typically trying to sell it because they don't have enough tax advantage to give it to universities. We have a huge opportunity here if the right incentives are offered to these larger corporations -- the advantage being that, number one, it prevents them from tearing down a building just to avoid taxes, which the State is not going to see anyway because those facilities are going to be gone.

Number two, I think it really enhances the opportunity for mentoring these start-up companies if they're really in close proximity to the pharmaceutical, biotechnology, life sciences businesses that exist here. I think that energizes their opportunities, it energizes their people, it gets them in closer proximity to start-up companies. And attracting start-up companies is a very important aspect of this -- not only start-up companies from outside of the state, but start-up operations from the universities that are right here.

The environment for venture capital has changed. And, today, it's no longer going out-- And I've raised many tens of millions of dollars for my start-up companies. And the issue has really changed over the past five years. It's no longer a situation where: "Let me show you how much money I'm going to make you." It's a situation where investors now want to know, "How am I not going to lose money?"

And so I believe one of the key roles here is to de-risk technology. And de-risking technology -- what I really mean by that is carrying it further along, not only to prove that the technology works. Because university technology in a licensing environment has been

successful, but not as successful as it should be. Actually, start-up activities from the university are typically a hundred times higher return on investment than any kind of licensing activities, especially when you take out these blockbuster drugs that are very rare.

In addition, the other interesting statistic here is that 50 percent more often will a product get to market if it's through a university start-up versus throwing it over the wall to a company whose focus changes over time, who may actually be licensing technology to protect another product -- all kinds of reasons.

And we have this valley of death, if you will, that I think is important for us to fill. And one of the ways of doing that would be to use these facilities -- offer them actually free of charge, give the companies some tax incentives since you're not going to see that money. Give the university start-ups maybe a free home, that mentoring opportunity that is invaluable for a start-up operation. I know there are a lot of incubators around, but oftentimes they charge for space. They don't get the kind of mentoring that can be provided in some of the large companies.

And so I would really encourage you to think about those kinds of opportunities that are, in my opinion today, opportunities. They don't take a lot of money from the State, which we don't have. They don't take a lot of money from industry. And the de-risking -- the further that we can take technology-- And I can't emphasize this enough. Investors invest in things based on risk. And the risk profile of an investment is determining who gains from that investment. And the earlier you do it -- which universities are typically doing at the end of a -- "I proved it worked in a laboratory once with a strong wind behind me," and then license that

technology out. The value of that is typically going away and typically leaving the state. And so the encouragement that I have is to take those technologies -- not only prove the technology themselves, but also prove the business model, especially as it relates to analytical instrumentation, medical diagnostic instrumentation. Prove that this actually works, prove that it works in the real world, and take it to that next stage -- is an area that, I think, is really critical to encourage, and doesn't take a lot of money.

I would also encourage more university spin-outs. They are very successful. Universities are limited as to what they can do. Certainly some of the public universities are extremely limited as to what they can do. And I think that we need to find ways of helping people get their technology out of the university environment, because it's not a real environment. They only get an understanding of what's needed by being in the real world and being at a pharmaceutical, or diagnostic, or life science company that has space, that can provide some mentoring and energize their own staff a little bit. I think it would be very, very beneficial in the short-term.

Finally, I have some just other minor thoughts, but very major issues. The FDA slow-down is very significant. And the 510(k) process now has really been extended and is really being forced toward PMAs. The use of predicate devices by the FDA, I believe, is changing the landscape of getting new technology out. The slow-down of an extra year or two in getting PMAs approved has been and will be disastrous. I've met with several companies, very large corporations in New Jersey, that see this as a huge issue. And as it relates to start-ups, it's even a bigger issue.

So we don't have the money, but we need to help these people and find ways today to attract more companies. Everybody else has been out there for a long time. And I would encourage some of these other thought processes to solve some of the problems in the immediate future.

Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you, Mr. Kahn.

DIPANJAN NAG, Ph.D.: Thank you, Madam Chair and other members of the Task Force, for giving me the chance to talk today.

I did not prepare a full testimony, but I thought I would just go through some key points of what all of my colleagues have been discussing in the area of life sciences research and also technology commercialization.

My name is Dipanjan Nag, and I am the Executive Director of (indiscernible) Technology Commercialization. I came to New Jersey less than a year ago, so I'm still learning a lot of the landscape. But I did spend some time in the state of Nebraska and in the state of Illinois, so I can draw from some of the experiences that I had over there.

Just as a way of background, I am a scientist who turned bad and went into more of the management side of things. (laughter) And I jumped into technology commercialization, as most people do, by accident. And here I am at Rutgers. And just to give you a quick summary of Rutgers -- most of you know about Rutgers -- we have 2,700 faculty members; we have 38,000 undergraduates, we have 13,000 graduate and professional students; 100 bachelors, 100 masters, and 80 doctoral professional degree programs. So we are a pretty large institution within the State of New Jersey, and we are also one of the 63 AAU universities in the U.S. We have 370,000 alumni, and 200,000 are in New Jersey.

In 2009, Rutgers brought in \$391 million in research funding, and that increased to \$433 million in Fiscal Year 2010. And the reason I mention all these numbers is, this is a direct investment in retaining jobs and retaining people within the State of New Jersey. The basic research that we provide-- Each dollar that is spent, \$0.70 is spent on a student or a post-doctoral research fellow who is working in that research program. The other \$0.30 are typically spent on other reagents and things of that nature that are needed for the research, which typically goes to a U.S. company.

Now, all of that said, we are performing a lot of basic research. And at the end of the day, that research needs to be translated to the jobs that I think we are talking about today. And how has Rutgers contributed toward that? Well, I will give you some quick examples just to keep the comments short.

I will cite -- the first one is TYRX pharmaceuticals, and they're based out of Monmouth Junction. It's a 10-year-old company based on a technology by Professor Joachim Kohn. And it's a polymer which is used for creating a mesh, and it has imbedded antibiotics in it. So if you need a cardiac pacemaker or some device, you put that in that mesh, and you would insert it and put it inside the body. They're already selling products. In fact, this was their best month ever in selling products. So they are passed that struggle of PMA and FDA approval that my colleague was talking about.

TYRX is a great story to tell, because it started with some very basic research from NIH funding, and it took almost five or six years to develop that research to a point where the basic research could be made into a product concept. From that product concept, it's taken TYRX 10

years to come to this point where they engage more than 55 people, which are real jobs for the State of New Jersey, based on the basic research.

Another great example is REVA, which unfortunately is not a company based out of New Jersey. We would have loved to have a company based out of New Jersey and could take pride in it. But it is a global company, and it is based out of California. And it's a medical stent. It's a bioresorbable polymer which dissolves away; and is eventually going to, hopefully, replace the market that is captured by Abbott, at this point in time, for those medical stents. REVA recently went public in Australia. So it's a global economy, and they are taking advantage of that global economy.

The last one I will mention is also a start-up: TAXIS Pharmaceuticals -- very early stages. They have four people. They're based out of New Jersey. It was a collaboration between UMDNJ and Rutgers University. Professor Ed LaVoie came up with a series of antibiotics, and they have licensed that technology from the two universities. And they're trying to raise the initial stages of funding so that they can take the company to the next stage.

Now, all of this is a great story. And we have other -- 1,900 patents at Rutgers. We generate more than a hundred inventions every year. I'm here to talk about more of the challenges. So in the spirit of having a brutally honest conversation, I'm going to step right into it. We lack certain things -- not only at Rutgers, but every university, I think, will probably have the same opinion or at least share some of the same opinions.

Having a proof of concept fund, which essentially takes an early stage discovery and invention to the stage that it's a product concept or a

product, is critical for our success. Because when NIH, which has contributed very generously to Rutgers and other universities -- although we would definitely want more. But we doubled our research funding in a decade from \$150 million back in the early '90s to the \$430 million that we have now. A major portion of that is NIH funding. But NIH, NSF, all of them -- it seems like their responsibility stops after the basic research is done, and then this whole concept of the valley of death comes in, and that needs to be overcome. That's one of the struggles that we face not only in the State of New Jersey -- other states face that as well. But I think it's a New Jersey challenge as well.

One of the programs that we explored when I was in the state of Nebraska -- which we used to call, before I went there and learned about it, a *drive-through state* rather than a drive-by state. That's a long drive, if you've driven through that state. And there's Lincoln and Omaha; and then the third largest city, on a game day, is the Memorial Stadium. (laughter) So there was not a whole lot of angel network capital, venture capital, all of that going on. So we looked at what was going on and how we could benchmark some of the other states.

We looked at Wyoming. Interestingly, Wyoming ranks higher in getting more SBIRs than most of the states that you will find, which are the so-called *very developed, technologically developed* states. The reason for that can be attributed to a program called the Phase 0 SBIR. Now, for people who know the Small Business Innovation Research program, 3 percent of the Federal grants are set aside by the Federal government for supporting small businesses. I believe that there is a strong need for taking our technologies into small businesses and hopefully creating a Genzyme, or

Genentech, or even a Google, maybe, on the IT side of things. So that support needs to be provided. And in the State of New Jersey, so far, I have not heard of Phase 0 SBIR program, which essentially supports the small business in taking a look at planning and submitting Phase 1 SBIR -- which as you might know, is about \$100,000 to \$150,000. And it's the hardest dollar to come by.

The challenge for us is not finding the Series A, Series B, or Series C venture financing, which I think some of my colleagues have already mentioned. It's finding the initial stage of capital. New Jersey Jumpstart exists, and they do invest. But, again, they're not investing in the typical life sciences, pharmaceutical, medical devices to IP. So there needs to be a funding source at the very first stage, which helps us in taking the technology to the marketplace and making New Jersey probably a better place for small businesses.

And I will cite one research and then mention a few points here. In my previous life, I used to sell patents for a small company called Ocean Tomo. We were the only company which was selling patents in a live auction setting like a Christie's or a Sotheby's. We sold hundreds of millions of dollars worth of patents. And when we were doing this, we did research in the area of: What is the valuation of a company? How do you value a company? And if you look back to the 1980s, an S&P 500 company -- 20 percent of a company's valuation in 1980 was in tangible assets. In the year 2000, it was actually 80 percent of a company's value was in tangibles. So there was an inversion of economy. And if you look at the global economy we live in today, I would argue that we are passed the knowledge economy part. We all know we are living in the knowledge

economy. It is the innovation which has kept us at the forefront of what we're doing today. If you look at the number of patents, if you look at the number of citations that the United States still has, we have a huge lead over Japan, Europe, Singapore, many of the other countries that we look at. But in terms of manufacturing and service, it's an eroding market whether we like or not. So the innovation part, I think, is a direct link to the intellectual property that we create in the U.S. as a whole. And taking advantage of that overall in the U.S. -- and definitely in the State of New Jersey -- I think would be a good way to look at it.

There are some things that we could potentially do to help jump-start our technologies being taken to the market. One is incentivizing angel networks. New Jersey Jumpstart is one network. But if angels invest money, it's a given statistic that 50 percent of their money would be lost. If there is some way we can incentivize, by tax incentives and otherwise -- that the most valuable money, which is the earliest money, can be supported by the State in some way -- I think that would be a huge initiative.

The other thing is, I mentioned the hundreds of millions of dollars in research funding that flows into the State of New Jersey. NIH or NSF has not taken the initiative that a percentage of that money be set aside for technology commercialization. And that would be a fundamental change in the way we think about things, rather than just investing in basic research only, which is very important to all of us. It would be important to take those technologies to the marketplace.

And last, but definitely not least, we sit inside the Pharma Valley, pharma belt, whatever brand we call it. And we have the pharmaceutical companies going out and doing a lot of collaborations in

Johns Hopkins. We'd rather have them stay at UMDNJ or come to Rutgers. So there has to be some incentive if they were to invest real research dollars in researching in the State of New Jersey -- they potentially could be incentivized.

I'll stop at that. Thank you very much.

ASSEMBLYWOMAN LAMPITT: Thank you very much.

D O N A L D H. S E B A S T I A N, Ph.D.: Good afternoon.

I admire your endurance. Do you need a break?

ASSEMBLYWOMAN LAMPITT: You've never been through budget season, have you? (laughter)

DR. SEBASTIAN: Sadly, I have.

My name is Donald Sebastian. I'm the Senior Vice President for Research and Development at New Jersey Institute of Technology. I've been in that capacity since the summer of '99 in various titles, but really as the equivalent of the Chief Technology Officer; but also a 33-year career as an academic professional, first at Stevens and then NJIT. In most of that life -- in fact, from my very first grant -- it's been at the interface between industry and university. So I have deep-seated feelings, and I can back it up with great thoughts, and great books, and speak to this issue. And it's a very critical one, I believe. In fact, perhaps the most critical one for New Jersey to consider now, because what was once probably the icon of the world in terms of the marriage of industry and innovation, we've seen so many of those key and core assets erode, slip away, and disappear.

And the life sciences are, perhaps, our last gasp, but also one with the greatest potential. Because I really, genuinely believe we are at the cusp of a whole new era of understanding with the life sciences. Rather

than being some oddity -- a different cat from physics, chemistry, and the physical sciences and engineering -- are now being understood from basics, from the ground up to the point where we're really understanding the chemical behavior of DNA, the proteins that create--

ASSEMBLYWOMAN LAMPITT: Which we learned this morning.

DR. SEBASTIAN: Did you? Well, good. Then I don't need to give you that lecture. (laughter)

ASSEMBLYWOMAN LAMPITT: We had that science class. We're good.

DR. SEBASTIAN: But that makes it now modelable, predictable, understandable, with much of the same rigor that is available to the other sciences; which now makes it safe for universities like mine, who have specialized in those, to be more than paying lip service to interface with the life sciences. And, in fact, our whole strategic plan has, as a core element, the connection of our key academic departments in engineering and science into this arena.

But I want to talk primarily about the whole concept of clusters. I know it's on the lips and minds of many now. We've had Professor Porter (phonetic spelling) in, and he's done work in Newark. Those concepts were delivered to the Council on Competitiveness in 1995. Our President then, Saul Fenster, brought it back and has been an advocate of it. And it's really an important concept to understand, because it also (indiscernible) with the new model of industry, one in which large, vertically integrated companies rarely exist anymore. You no longer have an AT&T that mines the copper to make the wires, that invented the plastics

to coat the wires and the modular plugs to connect the wires to the telephones -- the plastic they invented -- all so they could sell long-distance service.

Those simply don't exist. And while pharma has been, perhaps, the last survivor, it seems pretty clear that the inclusion and need to rely upon biological processes becomes something that probably breaks their ability also to be vertically integrated. And so we're going to see this idea of supply chains as something that has to be orchestrated and promoted, and that's what are the successful clusters -- things that know how to splice together the connection of small, midsized, and large companies that are necessary to take things from raw materials to finished articles in the marketplace.

In instructive study -- first reading assignment. Richard Lester, at MIT, conducted a multi-year study on clusters in the world. And, of course, we all walk in with a premise that it is just a matter of defining yourself as the right kind of valley. We just have the right name -- we're a Silicon Valley, we're a rubber valley. Well, the truth of the matter is, those conceptions can often be damaging, because we come to the belief that every economic cluster begins with a piece of academic research that then flows its way out across the boundaries of the university to industrialization. And that's the cycle that needs to be promoted. And what he found was that maybe once or twice in the last 60 or 70 years you had that kind of phenomena, and you've had many successful clusters that have been created throughout the world. And his whole premise and the whole work that he did was to examine the roles that universities played in different classes of regional economy. The creation from what he calls

indigenous invention disruptive technology -- however you want to talk about it -- that's a Silicon Valley model. That's one model. Another is: you just borrow somebody else's economy. Essentially you steal. And Taipei was an example in which they attracted the consumer electronics industry and created favorable conditions. Another is to modernize an industry that's lost its primary commercial outlet. Akron, in the rubber industry, lost the tire application, consumer tire -- took and became advanced elastomers for medical products in advanced applications.

In other places -- and a study group that one of our faculty members was involved in, in Finland, turned to modernize its industry. So it took its machine tool industry that lost its market and application in the Soviet Union with that collapse, and figured out how to add modern process control technology. And they became the dominant player nationally, with 95 percent of the gantries that you see in ports for cargo equipment. All of these are examples of different models and approaches in which the university role went from having the burden of having to invent the future to being more of a partner, and even just a convener of open discussion.

And so while we think that perhaps Boston, Research Triangle Park, Silicon Valley are there because the universities are primarily driving the economy-- I will give you some simple figures. Nationally, 3 percent of academic research is attributable to license fees from commercializing (indiscernible) property. At MIT, it's 3.5 percent; at Harvard, 4.5 percent, Tufts, .4 percent. Research Triangle Park lags the national average: NC State, 1.6 percent; UNC, .6; and Duke, .7. In Silicon Valley -- the only exception Caltech -- the whole UC system are below the national average, or

about there; Stanford with a whopping 7 percent. So if 93 percent of your time at Stanford needs to be devoted to something other than commercialization, it tells you that the heart and souls of the universities are not focused on developing commercializable property. What was it focused on? It was focused on becoming great universities, and competing in the arena and the metrics by which universities are measured.

To give you some good and warm feelings about your schools here in New Jersey, if we look at patent productivity -- how much Federal research or how much total research dollars does it take to produce a licensable entity? At MIT it takes \$12 million; at Harvard, \$10 million; Duke, \$17.6 million. Here in New Jersey, Rutgers does it for \$10 million, and that was in 2005 -- it may be even more effective now. NJIT does it for \$3 million; and UMD, and Stevens, and Princeton fall under that same category. So we're really much better than those iconic cluster states in terms of translating our research dollars into commercializable properties. What's the big difference? It's volume. It's roughly, in those cluster states, \$2 billion to \$3 billion of research funding that is coming in, and about a quarter of that coming into the State of New Jersey. So, again, where does that come from? It comes from competing as universities in the peer-reviewed scientific arena, which means that you're doing the sort of research that universities do. And that is another important model, which comes out of another piece of reading. It's a very short book called the *Pasteur's Quadrant*. Donald Stokes, from the Brookings Institute, published this in the late '90s. And he was trying to break through the rather stale rhetoric about basic versus applied research and translation, all of which tends to elevate the basic scientific discovery to be the start of everything. And as a

result, your development model -- it's a "put more meat into the grinder, and you will get more sausage out the other end."

His model said this: Let's take a look at why people do research. Some people do it just for the creation of fundamental knowledge to be put out into the public domain. And he has patron saints for these, and so he calls that quadrant the *Bohr's Quadrant*. Niels Bohr discovered the structure of the atom. And God knows that most of our chemical industry, and now what we know about biology, stems from that fundamental knowledge. But he didn't do it because of its commercial impact, he did it because the challenge was to increase our body of knowledge. And obviously that is essentially what universities have been charged to do by national policy since World War II. Vannevar Bush set that recipe and said, "Universities, that's your mission: create fundamental knowledge. In a sense, help us understand what we're doing so we can do it better and, by the way, train -- train the next generation of scientists. That's your fundamental preoccupation." And so you will see that that's what universities are primarily dedicated to.

Another axis or another dimension he calls the *Edisonial Quadrant*. And the driver is, you want to create products and services -- very strong commercial thrust. And Thomas Edison has never been accused of inventing a theory, but a little journey to his laboratories in Orange, and you can't help but be impressed by the extent of invention and innovation that came out of there. So there's an important difference here. One is about invention and innovation, and the other is about scientific discovery. Explaining and understanding creation are very, very different axes.

What makes this book so fascinating and important is that there is another quadrant. He calls it the *Pasteur's Quadrant*, or use-inspired research, in which you're connected to the marketplace. You do the work with an orientation towards a sector. You do it with an understanding of the problems in the market. But it's a place where disruptive technologies are created. You're not driven by creating new theories and so on, but you obviously need to be conversant with that.

And I would argue that the home of Pasteur in the United States has been our large-scale, industrial, corporate research and developmental laboratories: Bell Labs being the icon, but we had Sarnoff here, Westinghouse Research -- nationally, Westinghouse Research. The automotive companies had large-scale research and development -- GEC R and D (phonetic spelling), Exxon Research, and you go through the laundry list. And because we had large, globally dominant companies, they could afford to maintain entities that were not the Western Electric Research that was fixing the problems of the current operating division, but the people who invented the transistor, who invented the CCC devices that are in our cameras now, and on. These are people who knew their industry sector, knew those problems, but weren't slaves to the bottom line, to the operating division. And that has been a tragedy of American business model -- is, in fact, to take corporate research and development, and chain it to the needs of operating divisions. And in the end, it turned it from Pasteurian to Edisonian in its approach. And that's what we lost.

Why is that important? It's important for the very reason I just described: the nature of its research. It was also the human connective tissue that linked the needs of industry and the needs of the marketplace,

and back to the academics. Those were the people who went to the national society meetings and intermingled, and they brought back issues and problems in the academic community. They were the bridge in which the time scale of academic research could match with the time scale of the people in corporate research and development.

So how do we address that? The truth is: We can't look to Massachusetts or North Carolina for that answer, because they've not figured that out yet either. We can look around the world and see that there are many examples of public-private partnerships that create Pasteurian-like environments, like the Fraunhofers in New Jersey. I just came back from 10 days in China and saw the extent to which they have industry-sponsored, government-sponsored research centers that focus on these sorts of needs. And guess what? We had it. We had the recipe, we didn't have the implementation.

So I would encourage you to dig out the Governor's Commission on Science and Technology report from the Tom Kean era that recommended the creation of industry-sector focused, university-sited research and development centers that would, in fact, be anchors that would keep an industrial base -- that sadly has disappeared, in many cases. But the formula is still the right formula. And I think one call and one recommendation I would make is, in fact, to go back and redo that study now in 2010 instead of 1980-X -- '82 I think it was -- in the context of the industrial base that we have now, and ask: What went wrong, and how can we do it right? Because the concept was the correct one. Unfortunately, we executed it and allowed us, the universities, to begin to self-define success in metrics that were good for universities -- adding students, publishing papers,

journal articles, conference papers, and so on. That was the wrong axis. That has to be done in the university sector. And, of course, we heard, and I can add to, the litany of reasons why we need help to be able to do that job well, to be great universities.

But if we want to help our industries, we also need to find a way in which we can create kind of focused, disruptive technology generation engines that are these research and development centers to serve a sector. Because no single company can sustain that. And if we can figure out how to do that here in the country, we'll have the rest of the country beat. And we'll be at least equal to, if not ahead of, many of our other international competitors.

If that's not enough-- (laughter)

Before you go, you asked a question which I can answer.

ASSEMBLYWOMAN CASAGRANDE: Okay.

DR. SEBASTIAN: So I will take it-- You asked about the healthcare IT. I wrote that proposal in the State of New Jersey. I brought in the \$23 million.

ASSEMBLYWOMAN LAMPITT: Poor Caroline.

DR. SEBASTIAN: I'll be quick.

ASSEMBLYWOMAN LAMPITT: She has a young child she has to get.

DR. SEBASTIAN: So the good news is, the New Jersey Health Information Technology Extension Center is up and running. We're about to go, very aggressively, with programs in every community college throughout the state at least once a month, maybe twice, to get the doctors in to understand the whole business proposition, as well as healthcare

proposition, moving from paper-based records to electronic healthcare records systems. We are also the home for one of the three major experiments in health information exchange technology, which is linking Newark hospitals. It's creating the technology base so that doctors are not islands of IT automation -- but be able to hook up, then, to the clinical labs, with other doctors, with the hospitals, with the insurers, with all the players. So we actually now have a system in which your record can go where it has to go, and the information can be pooled.

And we've also created the University (indiscernible) Innovation Center. It will allow us to sit on top of what's happening in terms of implementing the best available current technology, and use that as an engine to drive new ideas and new processes that will naturally come as people migrate from the sequential paper-based records systems to an integrated IT infrastructure. It's really very, very exciting. It's a big load. The Federal money is really just for two years, and we have to convert more than 20 percent of the state's physicians in that time. It's a reimbursement model, so we don't get the money unless we're successful in getting them not just to buy and install, but to demonstrate 25 metrics of what's called *meaningful use*. But we're confident we can do it. It's going to be a really important engine. And as Malcolm has said, in addition to the traditional pharma industry, these are other examples of allied healthcare professional activities that are going to benefit -- that are going to be huge growth areas, and will also benefit from some State collaboration and investment.

ASSEMBLYWOMAN CASAGRANDE: Thank you.

DR. SEBASTIAN: I'm sorry. Because you asked that, I didn't want you to leave before--

ASSEMBLYWOMAN CASAGRANDE: No, I appreciate it.
Thank you.

DR. SEBASTIAN: Real quickly, a couple bullet points. It's been raised several times -- the issue of regulatory issues -- the problems of regulatory issues. I started the State's Manufacturing Extension Program. I know, from 15 years with that activity, how painful it often is for companies to be able to expand, do new things -- not just because of the regulations themselves, but because the implementation is not coordinated, and the decision process takes a long time.

I've always been an advocate of building and rebuilding, if you will, our production sector. We don't want to call it *manufacturing*, because that brings up images of sweat shops and environmental pollution. I can tell you again, from my trip to China, I saw places where there were only five people working on an advanced production line for the glass for solar panels -- two football fields long, highly instrumented. These are where the jobs are. And it's not because it's \$0.10 an hour labor, it's because they're highly trained and they're highly focused.

Research needs and wants to be close to production. Again, we want to focus not on the academic research, but focus on the industrial research. There's a reason why we don't have Exxon Research and Engineering here anymore -- because Exxon is not producing oil in New Jersey anymore.

Our pharmaceutical companies are no longer producing pharmaceuticals here in New Jersey. At one time they did. And why? Because the petroleum companies were their primary suppliers. That has all drifted elsewhere, and so we have a very dangerous situation here, which,

again, my friend Richard Lester gave a name. He calls it *hollowing-out*. As companies become bigger and bigger, and more successful, and start to globalize, they rely less and less on the local economy and more and more on -- it could be anywhere.

And so now we have a pharmaceutical industry that's mostly rooted here because corporate headquarters are here. It's very easy. And we're seeing it's very easy to move R and D, and other elements out. And before you know it, it may also be very easy to move corporate headquarters elsewhere as well. It's a big danger. If we can start to create the conditions where the entire enterprise needs to be here, and where we understand how to link up where some of their future feeds would be -- which is now the emerging biotech -- and how do we put those two together; being on the front of that and making that -- assist in that happening is really fundamental, I think, to keeping this anchored here.

ASSEMBLYWOMAN LAMPITT: Is that cyclical? I mean, given the pharmaceutical, given the petroleum-based products, is that something that we would see a trend -- it's a 10-year cycle, it's a 20-year cycle?

DR. SEBASTIAN: I don't know that it's cyclical. I think it could become irreversible, meaning once you lose them, it's going to be very, very difficult to get them to come back. If somebody else creates, now, the more attractive conditions for pharmaceutical headquarters to locate, for whatever reason -- because it's just an office park kind of mentality now -- then how do we start to bring them back? And how do we not have the biotechnology companies leach out and move as well?

We have, at the universities, infrastructure problems. As you move into the life sciences now, laboratories are expensive, the equipment and state-of-the-art equipment is expensive. And these are not things you could typically get in a competitive grant situation. The presumption is that the universities have these already. In many states, they provide for the infrastructure for the state universities. You don't have to go out and bond to do it. The states provide them. The states may bond, but the universities don't have to incur that debt and then lump that into the tuition base. And I think you know the sad history of funding for our universities. So we all recognize and appreciate the current problem, but this is a 20-year-long problem. I don't think our base appropriation has changed in 20 years. And yet, clearly, the cost of running the university has almost tripled. And so the burden it places ultimately gets passed on to the student.

ASSEMBLYWOMAN LAMPITT: Thank you.

DR. SEBASTIAN: We talked a little bit about intellectual property. Again, we all love the blockbusters, the Gatorade story -- of the patent that becomes a blockbuster. And if you look inside even the most successful universities--

ASSEMBLYWOMAN LAMPITT: I keep trying to find the one thing everybody needs. (laughter)

DR. SEBASTIAN: Everybody has one of those, right?

ASSEMBLYWOMAN LAMPITT: Yes, just one. That's all I need.

DR. SEBASTIAN: And that's it. And they have a lot of misses.

But what we've learned, and where we've been successful in commercial and intellectual property, is that most academic research is of a smaller scale -- that it doesn't become a sustaining contribution from which you can build a company. But what is successful is if you can put together intellectual property from multiple universities. And there are patent-pooling companies that begin to tap into related projects and form a platform. The trouble is, right now many of those commercial firms are doing it with an intent on penalizing, on punishing companies, on charging them for infringement as opposed to commercializing the entity. It would be a wonderful activity for the State of New Jersey to start to find a way to manage its portfolio patents across all of its universities, to be cognizant of the things that are going on, and to help commercialize pools of patents that come from the different universities to assist in identifying management personnel, people who can begin to take these things. Because the university faculty shouldn't be doing that. Very often the graduate students are not mature enough on their own to do the business side. We have a wealth of management and, unfortunately, displaced management talent in New Jersey. Creating a clearinghouse where we can begin to match people with particular intellectual property opportunities -- again, a valuable contribution that needs to be managed at the State level. If we all tried to do it ourselves, it's not going to have the impact if we try to do it through our underfunded -- in this case now, unfunded incubators as the point of attack.

The issue of getting across the valley of death -- another one. The intellectual property that comes out of universities usually comes out of basic scientific studies. It needs more maturity, it needs more proof of

concept before people invest. And that's not a place where you can get the external funding to take back. That's another consideration and issue.

Please don't penalize us for out-of-state students. (laughter)
We are not closing the door to New Jersey students. Ninety-five percent of our undergraduates come from New Jersey. But we have capacity. And yet we have to pay a penalty if we don't overcharge, relative to the national competition, students from out of state. It's an important way in which we can begin to build additional tuition revenue. I'd rather have \$20,000 from an out-of-state student than have them turned away because the number should be \$25,000 and they can get a better deal elsewhere.

And with respect to STEM -- I don't want to--

ASSEMBLYMAN CHIVUKULA: Who sets that number -- out-of-state tuition?

DR. SEBASTIAN: I think it comes from OMB. It comes from the State. They came up with a formula to predict what ought to be the fair, out-of-state tuition.

ASSEMBLYMAN CHIVUKULA: Fix it.

She's going to fix it. (laughter)

That's it; it's done.

ASSEMBLYWOMAN LAMPITT: We'll look at it again.

DR. SEBASTIAN: I am trying to focus on things now that I hope you can help us with.

ASSEMBLYWOMAN LAMPITT: Right.

DR. SEBASTIAN: And the last one, with respect to STEM, is we really need to fix our curricula standards. I've got young kids in the system, and I'm pained, frankly, by what they're not learning with respect

to math and science. My oldest is a seventh grader and really hasn't had anything other than earth science, ecology-type science in seven years. Study after study shows that decisions about life-long appreciation for math and science is made by fourth grade. And so we want our kids to go into the industries that are around us. But in the first four years, they're really getting nothing but things that give them bad messages.

ASSEMBLYWOMAN LAMPITT: Because most of the teachers who are teaching them aren't science teachers.

DR. SEBASTIAN: And so we have many programs. I won't go through the list of things we are doing in this area. We have many programs. But in the end, none of these things will have an impact if the--

ASSEMBLYWOMAN LAMPITT: The fourth grader doesn't stay.

DR. SEBASTIAN: --ASK tests don't reflect -- if the curriculum standards, which are then measured by the ASK tests, don't reflect that connection between the classroom principles and theories, and the things that are the real world applications of science.

Thank you.

ASSEMBLYWOMAN LAMPITT: Thank you.

Dr. Palladino, bring us home.

M I C H A E L A. P A L L A D I N O, Ph.D.: Thank you, Madam Chair.

Thank you for staying here, Assemblyman Chivukula. I appreciate that.

I appreciate the opportunity to speak to the Task Force.

I'm going to come at this from a different angle.

I'm Michael Palladino, Dean of the School of Science at Monmouth University. I'm trained as a molecular biologist and geneticist. I maintain an active research lab where we primarily look at antimicrobial and antiviral genes and proteins that protect the male reproductive track from bacterial and viral infections.

And my approach, as I say, is a different angle, and I'll just sort of put out some proactive ideas. We'll structure-- And I will keep my comments brief, given the hour. But we'll structure around the three fundamental questions -- to the three fundamental questions that were posed to this panel with respect to life sciences and other universities in the state.

And I really want to emphasize, in many ways, the role of the nonresearch universities in this paradigm. Because if we really want to look at this, comprehensively, you need to consider the model.

I will say at the outset that as the Task Force thinks about its recommendations on what to do on life sciences, moving forward, I would encourage the Task Force to really ask the very fundamental question as we think about resources here, recognizing that, yes, there are resource implications as we've heard all day. But I would encourage the Task Force to ask the very fundamental question of: What are the costs of not changing the infrastructure for the life sciences in this state? Essentially, what are the costs of maintaining the status quo? And I think those costs are really very significant in many ways.

Shifting back to the nonresearch universities, as it were -- the so-called *teaching universities*. I'm here representing Monmouth University. But that would include a range of other great institutions in the state -- the

Riders, the Montclair States, the TCNJs, etc. A big part of our product then is the student, it's the pipeline, it's the next generation scientist, technologist, engineers, mathematicians -- the STEM pipeline, as it were. And that really is a critical pipeline in the state that we need to continue to feed.

What a lot of folks don't realize -- and maybe this is not news to people in this room -- but a lot of folks don't realize that the undergraduate pipeline really represents the biggest pipeline into the graduate programs. If you look at the majority of students who enter the life science graduate programs, they start off at the small teaching institutions. They don't get their start at the big research universities. They start at the smaller teaching universities.

If you look at Nobel laureates in physiology and medicine, U.S. Nobel laureates have predominantly come from, on the undergraduate level, the small school, liberal arts type of environment. It's where they got their start. They did their graduate work at the high-powered research institutions. So it really is a key pipeline.

I'm going to mention -- and there's really no way for me to do this without being a bit self-serving -- but I'm a product of that pipeline in the sense that I grew up in New Jersey. I grew up in Bridgewater. I went to Trenton State College -- it's hard for me to say College of New Jersey -- but went to Trenton State College. I had a faculty member there who got me in his research laboratory and lit a fire under me. He was far better for me than any didactic class experience I had. I loved it. It was the catalyst for me.

ASSEMBLYWOMAN LAMPITT: I'm hoping my son has the same results. (laughter)

DR. PALLADINO: Wonderful. It was the catalyst for me that moved me on to my career path. I spent time in the Department of Molecular Biology at Princeton -- another fantastic university. I left the State of New Jersey for graduate school. I went to the University of Virginia, but was drawn back to New Jersey largely for family reasons. I find myself in the position now of being a faculty member at an institution now, having a leadership role as Dean of the School of Science. So the pipeline works.

And I will add that I see this perspective on the academic side really across the nation. I'm fortunate in that I'm a co-author of the leading undergraduate biotechnology textbook in the world. I'm a co-author of one of the leading genetics undergraduate textbooks in the world. And I see the range of issues that educational institutions grapple with in the life sciences, really across the country and around the world.

At Monmouth University, we have about 600 students in the sciences, about 50 faculty members. A little over half of that is dedicated to the life sciences -- biology, in particular, being our largest program. I came to the institution at a time where I had the first NIH grant at the institution. And now we have many faculty members who are competing and getting NIH grants and NSF grants. And those are grants largely targeted for the teaching institutions, the undergraduate institutions. And they are designed to engage undergraduate students in the research process.

The reality of it is, students don't learn about research and they don't learn about the sciences by listening to their professors talk about it,

or reading about it in a text book. You learn science by doing science. And so having active research experiences and active engagement experiences for students becomes critical, and those are some of the things that our many good teaching institutions in the state can do. That's really the key training for your next generation of scientists.

As examples of that, for instance, we have a summer research program where we have 80-plus -- this summer we had 80-plus students and 15 or 16 faculty members working on original research projects. Many of those projects were externally funded projects. That also includes high school students. We expose high school students to the opportunity to come in and engage with college and university faculty, and students on research projects. Those students are publishing their work with faculty members, they're presenting at conferences. Those students are moving off into graduate and professional schools.

A second example I think it is important to consider is, we focus a lot of discussion around, really, the health sciences of the life sciences. But I think we need to continue to remind ourselves that an extension of the life sciences really is integrally related to what's happening in the environment. And when you look at the environmental sciences as a critical component of the life sciences, the relationship between the environment and linkages to human health is crucially important. And we have a number of focuses there, through some of our centers of excellence, where we're doing a lot of coastal monitoring and trying to understand how the impacts of various sources of pollution -- coastal estuaries, for example -- can be used to inform us about best-management practices. So it's an important linkage and consideration. And I think given our coastal

geography, we've really dropped the ball in a lot of those areas in promoting that agenda.

Developing partnerships with other institutions, both in and out of New Jersey, I think creating pathways for students becomes critically important. We're spending a lot of time working on agreements with community colleges, with high schools, with graduate programs, and professional programs, including places here, but also outside of the state, where you can provide a pathway for a student. You can say to a student, "If you want to be successful in the life sciences, here is where you start, and here are open-door pathways where you can seamlessly move from institution to institution and end up where you want to be," and also see where that end point will take them out into industry.

We've heard many times today there are way too many silos in this state. Some of the agreements that we've developed have been out of state for the simple reason that, with one call you get results. And so you go that pathway of least resistance. But, again, we need to break down some of those walls and some of those silos to have more of that one-call action.

Biotechnology High School is a place that's near and dear to my heart. I'm on their Advisory Board. I was one of the founding members to develop that school. If you look at that model -- and, in fact, the model of many of the Monmouth County Vocational School District schools -- it really is an exemplary model for moving students at a very high level -- moving them into a very rigorous, pre-college training environment. And those students are becoming the superstars. But the reality is, we're losing

most of those students. They go all over the place. They go to the who's who list of institutions, and there are a variety of different reasons for that.

Engaging middle school students is a critical area. I mean, we're fortunate. We host a program called the Stars Challenge, which was developed by two retired engineers. This has become their second life passion. And it's really about providing a challenging, after-school program for students and engaging them in real-world, scientific problems. We need more examples like that throughout the state to really engage our talent pipeline.

Touching on a few elements, I would put out there really building, in many ways, on other things that people have mentioned today about how the State can promote and help develop the infrastructure. Leveraging the capacity of our institutions, at all levels, becomes critically important. We've heard that a lot. But I can tell you, as you think about states like Delaware, California, Massachusetts, North Carolina, Iowa, etc., it's even relatively simple to have access to the leverage instrumentation capacity in that state if you're a small company or a small business who has what is just a simple starting point. We don't do a good job of collectively cataloging that and promoting that within the state. And that's a relatively low-cost, relatively simple thing you can do.

For example, we had a series of meetings last week with a small biotech group that's looking to locate to the Monmouth County area. Just knowing that you have a high-field nuclear magnetic resonance spectrometer that they can beg and borrow so they don't have to spend \$500,000 to do that is a big deal. But they couldn't find that anywhere if they looked up and down the State inventory of resources, because it really

just didn't exist. And so taking a measurement, taking that baseline of capacity in the state and actively promoting it would be one very early, relatively low-cost step.

Using that to promote an agenda to get industry engaged with higher education is crucial. They should be interested in that. But that becomes difficult to do. Obviously, we're providing that talent pipeline for industry. They should want a liaison and help us develop our curricula, help us draft our curricula, help provide internship and employment opportunities. It's often difficult to engage them to do that.

For many of the other peer partner schools within the state -- and Don sort of alluded to this -- there are significant infrastructure issues. If you want to keep the best students in the state, they want to go to facilities that at least look better and feel better than their high school facilities. And in some cases throughout our state, we simply don't have that. Despite the great things that are happening in those facilities, there are significant aesthetic issues, there are significant facilities issues. And I just spent the last couple of days visiting places like Hamilton College in upstate New York and Colgate, and looking at tremendous infrastructure investments into their facilities that are designed to attract their best and brightest and keep them within the state. How do we get industry to recognize that? How do we get the people we think about as angel investors and venture capital investors to think about a different paradigm, a different place to put their money -- investing in our next generation STEM students.

I will finish with one other area of promotion, going back to some of the things that were mentioned earlier with respect to the

educational system. As many people have mentioned today, really capturing the interest of middle schoolers becomes crucially important. When we talk about a K-12 continuum-- But the reality of it is, for a student who gets to high school -- if they aren't turned on by the sciences at that point, it isn't going to happen for them. They might get involved in their high school play and decide now they want to be theater major. But if they've developed science phobias by high school, it isn't going to happen. We know middle school is a critical proving ground. We take all that intellectual curiosity of children -- the reason why children are out flipping over rocks, out in streams, out in the woods, innately curious about life, wanting to know how things work, taking things apart and putting them back together again. And when they get into -- well, we can say K-12 -- but when they get into elementary school and middle school, we pretty much stamp out a lot of that intellectual curiosity, because the way they learn the life sciences becomes memorization and regurgitation of facts and figures, and not application.

The other critical piece of that is: We spend a lot of time in our educational system telling students about what we've already learned. The life sciences become an accumulation of facts that we've learned. And our teachers -- and I spent a lot of time in middle schools talking about this -- our teachers don't spend enough time talking about what we haven't learned, because that's where all the exciting questions are. And so we should be spending a lot more time about all the things of which there's a lot more that we don't know the answers to. And these next generation students are going to help us solve those questions.

That becomes the great challenge. It's not how much you can cram into an empty vessel -- their head at that time -- facts and figures about the sciences. "Let me give you a little bit of basics, but let me show you all the challenges -- the grand challenges that are out there to solve and how you can play a part in solving that." We don't do that, so we don't engage those students, and we lose them.

Thank you for your time.

ASSEMBLYWOMAN LAMPITT: Thank you.

Thank you, all. Thank you very much.

Upendra, do you have any questions?

ASSEMBLYMAN CHIVUKULA: No. I just want to thank-- that's a great presentation. Sorry we ran out of-- We lost three members. We lost them because they had prior commitments.

I think this is good. It was a very stimulating presentation. We have a lot of work ahead of us.

ASSEMBLYWOMAN LAMPITT: We do.

ASSEMBLYMAN CHIVUKULA: And we'll keep working at it.

ASSEMBLYWOMAN LAMPITT: I, too, would like to thank everybody here -- the panelists here for waiting so patiently to share your thoughts, and your professionalism, and your talent. In general, I think this is -- the life sciences is something that we are taking seriously. The next meeting of the Life Science Task Force is going to probably be January, where we're talking about the regulatory part of this. There are a lot of take-aways for all of us. Josh here took a tremendous amount of notes. And we really ran the gambit of talking about higher education: the

regulatory part of it to the science part of it as well. So I think this was a really great jumping-off point for all of us.

I certainly would like to thank UMDNJ, the Cancer Institute of New Jersey, Dr. DiPaola, Dr. Scotto, Dr. Owen, and everybody here at UMDNJ who made it very easy for us to be able to host this first Life Science Task Force here.

All of the panelists, truly, thank you for your time and your professionalism. I think that we here in New Jersey are not short on the talent pool, by evidence of today.

Thank you, all, very much.

(MEETING CONCLUDED)