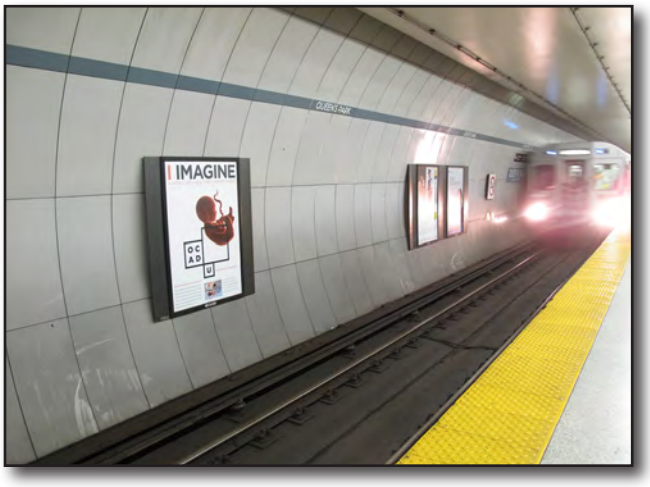
Francis LeBouthillier Articles and Press

Surgical Simulation

OCAD University I Imagine media campaign. The creative campaign showcases some of the ground-breaking work produced by OCAD U's faculty, alumni and students over the course of the institution's 135-year history.

Eight distinct transit shelter ads are featured at locations around the downtown core
The campaign also includes on-line ads on sites such as BlogTO, The Globe and Mail, Toronto Star, Toronto.com and CBC.



OCAD University 2011/2012 Annual Report.
135 reasons to love OCAD University - #44

FACULTY PROFILE: FRANCIS LEBOUTHILLIER

> "The idea of being in touch is something people come to OCAD for — they come to be physically in touch with things."

The harder you work the luckier you get.

"Have you heard that?" asks Francis Lebouthillier, Chair of Sculpture/Installation at OCAD. But the equation needs rewriting because in Lebouthiller's case, the harder he works the luckier we get. As an artist, a professor and a medical model maker, Lebouthillier is changing lives.

Lebouthillier started his career in figurative sculpture and later added performance and video to his repertoire. Today, he produces incredibly detailed silicone models of fetuses and pregnant women's bellies for medical professionals to use as learning aids. "Having the technical skills required for mould making and bronze casting has been integral to developing the medical simulations. I use bronze-casting techniques to create the silicone fetuses."

Lebouthillier is now working with a team to secure funding that will allow for the use of rapid-prototyping technology in the medical model-making process. Somewhat like a 3D printer, the rapid-prototyping machine takes a virtual, computer-generated design and transforms it into a 3D model. OCAD introduced this technology into its studios last year.

Technology has always informed Lebouthillier's artistic practice. "At one point, I stepped forward into an arena that terrified me — multimedia performance art and video installation. It catapulted my career." Today he contemplates all of our readily available technologies, appreciating how they challenge us — in a good way — but insisting also that they'll never replace the physical connection to touch and learning through touch.

That Lebouthillier calls himself a visual, spatial learner is not altogether surprising. His parents were factory workers who used to bring home "piece work," assemblages that the family would complete in front of the television. "My parents made patterns from leather. For me, seeing how things are assembled in sequence and being able to visualize the progression from 2D to 3D was so valuable. It's something our students learn in first year and I think it's central to the building of things, as well as the communication of ideas to clients."

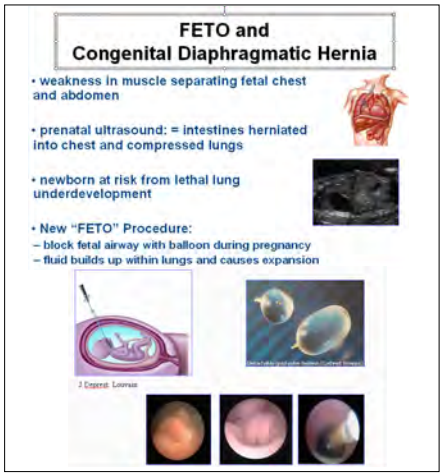
Lebouthillier, who started teaching at 25, still sees figuration, "that whole body of work," as the thing that grounds his methods and practice. And however keen he is on technology — the rapid prototyping is a fine example — he still returns again and again to the idea of touch. It is with delight that he describes how the doctors he works with call the newborn babies they deliver "fleshies." And it is with great seriousness that he discusses sculpture. "We've moved away," he says, "from the object that sits on the table, that sits on the pedestal — the modernist notion of what art is — to the place where the space surrounding the object and the individuals who interact with it are part of it. I think in some ways this has enabled students to make objects without as much investment. I actually see the object coming back into sculpture through technology."

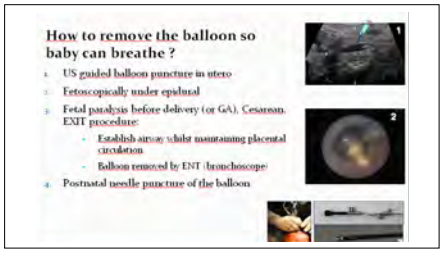
Faculty Profile:
By Larissa Kostoff OCAD
2008/2009 Annual Report

Simulator based team preparation for neonatal resuscitation, following antenatal intrauterine fetal tracheal occlusion, in the management of congenital diaphragmatic hernia.

R Windrim[1], P Campisi[2], E Kelly[1], D Baud[2], J Deprest[3], G Ryan[1], F LeBouthilier[4], SJ Yoo[2], P Kim[2].
[1]Mount Sinai Hospital; [2]Hospital for Sick Children University of Toronto. [3]University of Leuven, Belgium. [4]Ontario College of Art and Design, Toronto, Canada.

Introduction





Case

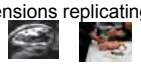
• Fetus with severe CDH had balloon inserted during pregnancy
• planned removal at birth

Challenges with Team Preparation for Birth:

• timeline: balloon had to be removed immediately after birth or potentially fatal airway obstruction
• lack of any experience with clinical task (novel case - first in North America)
• removal required coordinated care of 4 teams: Obstetrics, Paediatric ENT, Neonatology and Anaesthesia (approximately 15 staff in room)
• required endoscopic facilities at time of Cesarean

Methods

• A high fidelity fetal model was created (FLB) with simulated airway dimensions replicating fetal MRI measurements



Team Planning and Drilling for resuscitation:
• model-based
• all 4 disciplines
• multiple occasions
• systems trouble-shooting

•Techniques:
• variations explored
• repetitive practice

Results

• Elective Cesarean section "EXIT' procedure at 36 weeks gestation

• uncomplicated removal of balloon (see video on laptop below)

• neonatal resuscitation uncomplicated

• University of Toronto plans to join randomised trial of FETO for CDH.

Summary

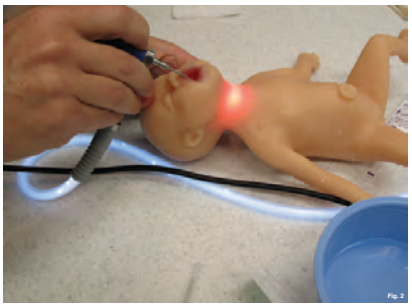
A high fidelity fetal CDH model allowed:
• safe planning of novel procedure (FETO balloon insertion)

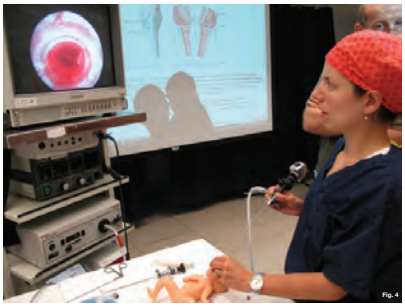
• team preparation for high-stakes procedure (immediate balloon removal at birth)

Acknowledgement:

Project funded by an Innovation Grant from:
The Network of Excellence in Simulation for Clinical Teaching and Learning

Conference Poster presented by Dr. Rory Windrim at The Network of Excellence in Simulation for Clinical Teaching and Learning - December 2010





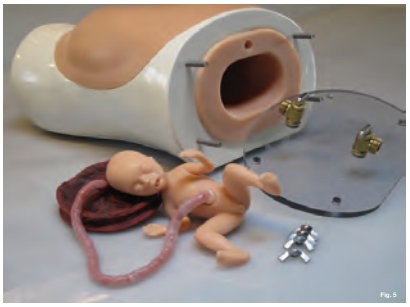


Fig. 1 Teaching fetoscopic endotracheal balloon occlu sion removal at Mt. Sinai Hospital's Surgical Skills Lab

Fig. 2 Teaching fetoscopic endotracheal balloon occlu sion removal at Mt. Sinai Hospital's Surgical Skills Lab

Fig. 3 28 Week-old Fetus with upper airway optimized for the teaching of fetoscopic endotracheal balloon occlu sion (FETO) to treat congenital diaphragmatic hernia.

Fig. 4 Teaching fetoscopic endotracheal balloon occlu sion removal at Mt. Sinai Hospital's Surgical Skills Lab

Fig. 5 Amniocentesis simulator, with 24-week old fetus umbilical and placenta

Photos: F. LeBouthillier, Fig.1,2,4,5 - D. Renelli Fig. 3

Surgical Training Fetus

OCAD University

Francis LeBouthillier, in collaboration with Dr. Rory Windrim & Dr. Greg Ryan of Mount Sinai Hospital, Toronto, Canada.

Francis LeBouthilier has been designing and manufacturing high-fidelity surgical simulators and medical models for over 10 years. These images depict two surgical simulators that were used to teach amniocentesis procedures and a highly specialized prenatal surgical intervention used to abate Chronic Diaphragmatic Hernia. These research projects were developed in collaboration with Mount Sinai Hospital and the University of Toronto Surgical Skills Lab.

The main goal of these research projects has been to create custom teaching tools that help medical practitioners to perfect their surgical skills within a controlled environment. Working in collaboration with medical research partners, including research teams at Toronto's Mt. Sinai Hospital and Women's College Hospital, LeBouthillier developed, designed and manufactured a simulator for fetoscopic endotracheal balloon-occlusion (FETO) to treat congenital diaphragmatic hernia (CDH) CDH is a condition where the wall of the diaphragm does not fully develop in the fetus. This has serious implications for optimal lung development. This procedure involves strategically placing a saline-filled balloon in the larynx of a 28-week old fetus to prevent vent the displacement of the developing lungs. This model is currently being used in the Fetal Medicine Unit at Toronto's Mt. Sinai Hospital, in the Texas Fetal Center at Memorial Hermann Children's Hospital in Houston, Texas, and at the UniversityHospital in Leuven, Belgium.

LeBouthillier also developed, designed & manufactured an amniocentesis simulator, comprised of a fluid-filled womb that contains a 24-week old fetus. This simulator has been optimally designed to reproduce the life-like feel of inserting a needle into the amniotic sac by reproducing, in silicone, the multiple densities and viscosities of tissue. The accurate placement of the needle into the amniotic sac to extract an amniotic fluid sample is guided through ultrasound. This device is used in many hospitals to aid in the training of obstetricians to refine their performance of this procedure to ensure the safety of the mother and fetus.

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PALS

www.sustainabilitypath.org

Conference poster presented at the Association for the Advancement of Sustainability in Higher Education (AASHE) Los Angeles Convention Center October 14-17, 2012.

RESEARCH MATTERS BECAUSE SCULPTURE CAN SAVE A BABY'S LIFE

Posted on May 10, 2012 by Patchen Barss

If it looks like a fetus, flexes like a fetus, and shows up on ultrasounds like a fetus, what is it?

If you're a surgeon-in-training, then it just might be an incredibly accurate medical model created by OCAD University sculptor and researcher Francis LeBouthillier.

LeBouthillier has spent more than a decade becoming an expert in a highly unusual combination of research areas: materials science, fetal abnormalities, foundry techniques, laparoscopic surgical procedures, and more.

"I made part of that fetus on my lathe," he says, pointing at one of his prototypes. A self-described "machine fetishist," his 750 ft2 studio is crammed with sheet metal shears, press drills, welding equipment, degassers, rubber and binding agents and other tools required to make finely detailed, three-dimensional models for surgical simulations.

Since his first medical job – creating two full-term fetuses for use at the Surgical Skills Lab at the University of Toronto – LeBouthillier has progressed toward increasingly complex models that have allowed doctors in many countries to master intricate life-saving operations.

"Doctor Rory Windrim at Mount Sinai approached me to do a 28 week-old fetus model that involved building the larynx and full airway," LeBouthillier says. The model is used to practice a procedure to treat a condition called "diaphragmatic hernia." In this congenital condition, the fetal diaphragm doesn't fully form, causing the stomach to expand into the chest cavity and prevent the lungs from developing.

Surgeons used LeBouthillier's model to practice a mindboggling operation, moving surgeons' tools into the fetus's mouth, past the larynx, and down the throat, inserting a tiny barrier – a fluid-filled balloon smaller than a pea – that allows the lungs to develop.

LeBouthillier has become part of a medical team whose advances have already saved many babies' lives.

"I feel very lucky to have these skills to do this work," he says. His research continues, exploring new possibilities including using computer-assisted 3D modeling to allow even greater precision, and retooling to create affordable training models for developing nations.

MAJOR FUNDERS FOR THIS RESEARCH

Major funders for this research include Dean's Fund, Faculty of Medicine, University of Toronto Department of Obstetrics and Gynaecology and Mount Sinai Hospital Network for Excellence in Simulation.

ABOUT THE PROJECT

Lead Researchers
Francis LeBouthillier

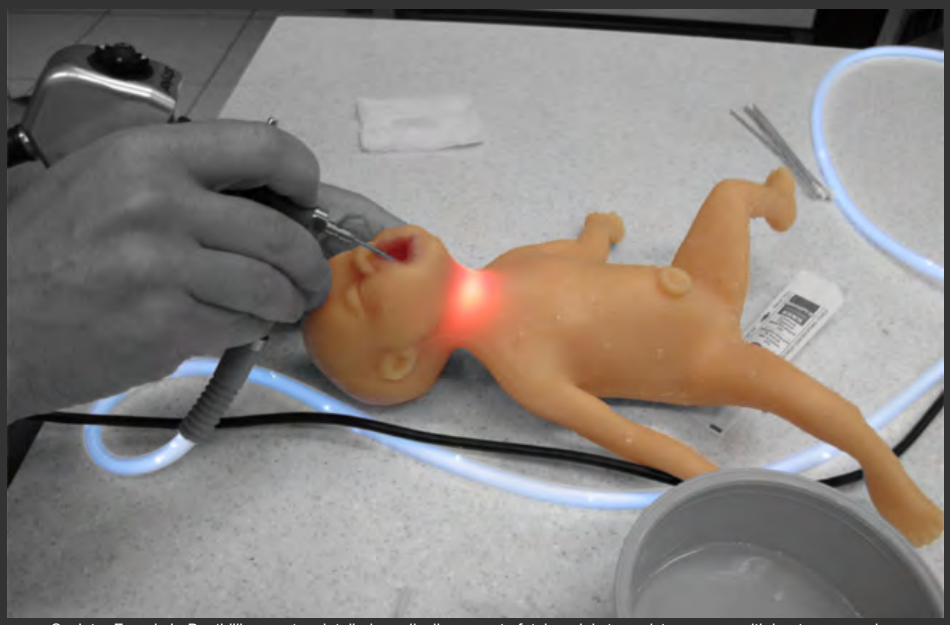
Institution
OCAD University

More Information
OCAD University

Research Matters campaign website content. This campaign is a collaboration among Ontario's 21 universities to find new ways to tell stories about how research is changing lives. May, 2012

EVERYBODY IS BORN

Posted on June 19, 2012 by Patchen Barss



Sculptor Francis LeBouthillier creates detailed, medically accurate fetal models to assist surgeons with in-utero procedures.

By Patchen Barss

“Everybody is born,” says Rory Windrim, a specialist in high-risk obstetrics at **Mount Sinai Hospital** in Toronto.

Not everybody has an easy time of it though. While the vast majority of pregnancies go smoothly, the small percentage that do not become a powerful focal point for both expecting parents and doctors like Windrim.

Consider a rare fetal condition known as “**congenital diaphragmatic hernia**” or CDH.

The diaphragm is a layer of muscle that separates the chest cavity from the abdominal cavity. A fetus with CDH lacks some or all of this barrier. Without the diaphragm, the intestine, spleen, stomach and liver can press up on the lungs, preventing them from developing properly.

A fetus doesn’t need lungs, but a baby does. That means a mother can carry a CDH pregnancy to term, and then lose the child immediately at birth.

Here’s what doctors can do about it: Using **laparoscopy**, they can work a tiny balloon through the womb, into the mouth of the fetus, down the throat and lodge it at the top of the lungs. With this barrier in place, the fetus’s lungs fill with fluid creating enough pressure to push back the abdominal organs. The lungs have room to grow.

But the danger isn’t over.

Doctors must remove this balloon just before the baby is born, so that her airways are clear when she takes her first breath.

How do you test something like this? How do you refine the procedure? How do you train surgeons in something so elaborate, and with such grave consequences? How can new surgical teams practice until they get it right?

Even less complicated in-utero treatments such as amniocentesis and fetal blood transfusions once had to be learned on the job.

The Research Matters campaign on-line interview with Dr Rory of Mount Sinai Hospital).
By Patchen Barss, Creative Director and Managing Editor, Research Matters (COU) June, 2012

“Practitioners of this kind of procedure went through a training program where a more experienced teacher mentored them with real babies and real pregnancies,” Windrim says. “The lay public might expect that the person starting the procedure had done it before. That wasn’t always the case.”

This form of training demanded great surgeons who also happened to be great teachers.

“It took a very experienced teacher where your hands become his or her hands,” says Windrim. “I was lucky enough to have one of those teachers.”

He is now a teacher himself, and is keenly aware of how stressful it is for many trainees to master such delicate, high-stakes procedures. His career, though, happens to have coincided with an expanded role for simulations. Not computer simulations – no graphics could duplicate the feel of a needle puncturing a uterus, or the physical reaction to lodging a balloon in a fetus’ throat. To test and practice this kind of procedure, they needed physical simulations. That’s where OCAD University sculptor and researcher Francis LeBouthillier came in.

“We contacted Francis to see if he could make models for some of these procedures,” Windrim said. “The first was an **amniocentesis**. Francis built a simulated womb and fetus that allowed trainees to practice the procedure without posing any risk to an actual mother or child.”

LeBouthillier not only had to research the medical procedure, but also had to find the right materials for his models. The material had to be ultrasound compatible. It had to be durable. A needle couldn’t leave an “optical scar” – which would cause the model to lose ultrasound transparency over time.

Rory Windrim: a surgeon’s hands and a sculptor’s simulation.

Sculptor Francis LeBouthillier

The partnership between sculptor and surgeon developed over many years, with new models allowing the practice of increasingly complex procedures, including CDH.

“This procedure is usually done between 24 and 28 weeks – we got MRIs of bronchi and lungs of babies at that age and asked Francis to create a simulation with accurate throat and windpipe,” Windrim says. LeBouthillier’s models not only allowed a medical team to learn how to do the procedure, it also helped them decide whether they should.

“The model has allowed us to step forward into a new area as carefully as possible. Every possible due diligence has been paid to making it as safe as possible for mothers for this still-under-investigation technique,” he says.

While it’s difficult to gather clinical data on the effect of simulation training on mother-and-child well-being, Windrim has no doubt that LeBouthillier has made a huge difference to the field. He is part of a team led by Mount Sinai’s **Greg Ryan** that has treated several challenging CDH cases, and attributes their success to their collaboration with LeBouthillier.

“It’s hard to see how else we could have prepared for that first case,” he says. “We worked it out step by step as a team with our paediatric colleagues at Mount Sinai and the **Hospital for Sick Children**. I can’t see how we could have proceeded as safely without Francis’ model.”

Opposite Jules Goss, 2012. The scribblings pictured opposite represent simplified versions of idea capture, as well as maps of processes for which solutions are being designed at Baycrest in Toronto

Health and wellness by design

By Kira Vermond

IN AN ERA OF HOSPITAL SPENDING CUTS, DOCTOR SHORTAGES AND LONG WAIT TIMES, DESIGN, ART AND CREATIVE THINKING COULD VERY WELL MAKE CANADA'S HEALTH SECTOR WELL AGAIN

"Should I take the elevator or the stairs?"

It seems like a simple enough question. Yet for Gayle Nicoll, it's one that's anything but straightforward. The OCAD University Faculty of Design Dean has long spent time researching how our physical environment has an impact on the simple health and wellness choices we make each day. She has even co-written a seminal book on the subject, *Active Design Guidelines*, which boasts a run of more than 10,000 copies distributed in 80 countries.

(And for the record, building open, accessible stairs rather than dim, unappealing fire-exit stairwells, encourages us to climb, she finds.)

Surprised OCAD U's focus is moving into the medical realm? Don't be. Nicoll's appointment effective July 1, 2011 is indicative of the university's commitment to merging design and health, not to mention using OCAD U's inherent strengths — creativity, imagination and innovation — to create new health-based systems.

"Designers and artists offer an essential perspective and ability to create environments, objects, processes, communications and policies that address the human condition," says Nicoll.

Or to put it another way, OCAD U students, alumni and faculty have the creative chops and lateral-thinking skills to envision health and wellness in a whole new way. Recent grad Jessica Ching turned her 2011 Industrial Design thesis into a company called HerSwab™, which allows women to conduct their own Pap tests. Wellness will even be discussed at the university's Urban Ecologies conference (see page 4) in June 2013.

There is a good reason to merge health and design thinking. Health-care costs are rising, the population is aging, there's an increase in chronic disease and need for long-term care. Add these challenges to an inflexible, massive and over-stressed system, and it's easy to see why innovation is so desperately needed.

In fact, one might argue that when it comes to design and wellness, there is no better or more salient match. Just ask any parent who has had to keep an anxious child calm before a medical procedure. Third- and fourth-year OCAD U Design students recently collaborated with Holland Bloorview Kids Rehabilitation Hospital researchers and launched ScreenPlay, an über-cool, interactive waiting room, complete with large projection wall.

The success of the project underscores the way design can help make an otherwise uncomfortable or scary situation more tolerable. A nicely designed chair has got nothing on that.

Problems need whiteboards

Design finds itself going through a parallel transformation. Once understood as a noun — i.e., a thing or product, what is ultimately created — design now finds itself moving into verb territory. Increasingly it's about the process, the thinking, problem solving, creating and becoming. And it's about inclusivity.


"Designers and artists offer an essential perspective and ability to create environments, objects, processes, communications and policies that address the human condition."
Faculty of Design Dean Gayle Nicoll

Take what Jules Goss has been working on lately. An OCAD U assistant professor and the former chair of Industrial Design, Goss is now the first designer-in-residence at a Canadian hospital.

"My job is to help people think about stuff, which is a weird hybrid between the educational me and the designer me," he says. "They're not always the same thing, but in this context they can be equalized."

In his brightly coloured basement lab at Baycrest hospital in Toronto, which houses three whiteboard-covered walls, Goss is bouncing around ideas about how to ensure that the most complex Alzheimer's patients are moved into long-term care with more dignity and less stress.

One tool? A simple video camera. Patients are filmed on good and bad days at Baycrest. That footage is then edited and put on a DVD for the new long-term care team to view. The DVD also includes personal information about the patient. Did he have a dog? Does she like to golf? What is the best way to handle his feeding?

Now Goss and his Baycrest team are looking for ways to share the material remotely. There's still work to be done around confidentiality and privacy but, by consulting with clinicians, families, patients, the hospital's IT department and other stakeholders, the project is moving forward one idea at a time.

"It has been an iterative process and the experience has been as important as the end result," says Bianca Stern. As director of Culture, Arts & Innovation at Baycrest, she started talking to Goss two years ago about a potential working relationship. "There's a lot of synergy between the way Jules thinks as a designer and what we need to do in terms of client-centred care."

Even before Baycrest partnered with Goss, OCAD U students in both faculties were commissioned for Baycrest projects — collaborations that helped win the university the Baycrest Chair's Proud Partners Award in 2012. Classes continue to visit the hospital to understand how people become attached to the spaces they live in. And with a new Master's in Design for Health on the horizon at OCAD U, learning will flourish.

Marking the medical

There's more to this story than design, however. For Bill Leeming, an associate professor in the Faculty of Liberal Arts & Sciences, the merging of medical and arts takes a more straightforward path. A sociologist, he studies technology's impact on medicine. In one large research project, he is comparing how genetic technologies are being used in Canadian and U.K. centres.

Genetics is a subject with traction. Leeming says he's still amazed that back in 2005 the technology needed to scan the human genome — our complete set of DNA — cost millions of dollars. Today, there's a test that will look at 60 per cent of a genome with a price tag of $1,595.

"You can buy one over on York Street, complete with genetic counselling services," he says. "This has created whole new possibilities around consumer testing."

In other words, families who have, say, a high cancer risk, could buy a test and try to find out if they have a potentially lethal gene. But this opens up a Pandora's Box of questions, according to Leeming. Does the person understand the information? What if one family member wants to know if a gene is present, but others don't? What should people do if they find out they have the gene anyway?

"There's a huge set of relationships and questions that enter into this that weren't there five years ago," says Leeming.

There is something else that interests him these days: how much his undergraduate students understand about genetics. When he started teaching his Culture of Science class 15 years ago, most didn't have a clue what a genome was or how DNA works. But now, after years of watching forensic shows on television and more discussion in high school, his students come to him with a basic understanding of what a genetic marker is.

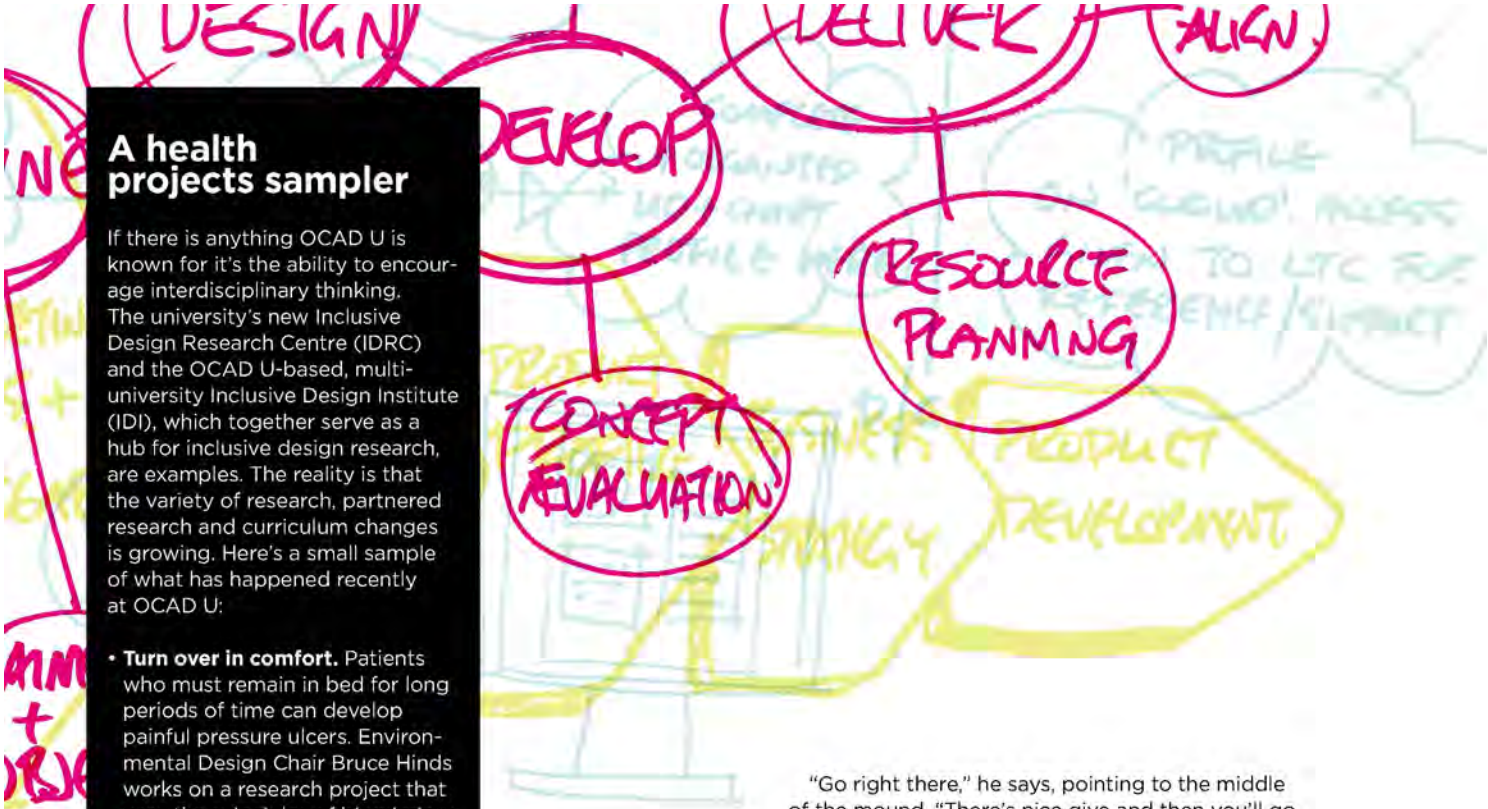
Art and craft of medicine

Like Leeming, Francis LeBouthillier, an OCAD U alumnus, assistant professor, and the former Sculpture/Installation chair, is interested in uniting art and health.

"Do you feel like doing an amniocentesis?" LeBouthiller asks as he turns away from the table at the centre of his beautifully chaotic studio to quickly grab a few items behind him. He then hoists a large, floppy mass onto the table. It looks like a pink, plucked turkey that has gone a few rounds in the ring.

As he inserts a long needle into the thing on the table to demonstrate, LeBouthillier takes on the demeanour of a practised physician: calm, quiet and accustomed to teaching a roomful of anxious medical residents how to perform complicated procedures. Then he passes the needle over.

Opposite page Francis LeBouthillier, Model of 28-week-old fetuses with upper airways optimized for the teaching of fetoscopic endotracheal balloon occlusion (FETO) to treat congenital diaphragmatic hernia. Photo by Dianna Renelli



A health projects sampler

If there is anything OCAD U is known for it's the ability to encourage interdisciplinary thinking. The university's new Inclusive Design Research Centre (IDRC) and the OCAD U-based, multi-university Inclusive Design Institute (IDI), which together serve as a hub for inclusive design research, are examples. The reality is that the variety of research, partnered research and curriculum changes is growing. Here's a small sample of what has happened recently at OCAD U:

- **Turn over in comfort.** Patients who must remain in bed for long periods of time can develop painful pressure ulcers. Environmental Design Chair Bruce Hinds works on a research project that uses the principles of biomimicry — and wasp tails for inspiration — to create a dynamic surface that undulates and moves with the patient.
- **Cast in a new light.** Mandad Tabrizi, an Industrial Design student and founder of Heal.X Innovation, is finding a new way to cast buckle fractures (minor bone cracks) in children. The system uses CT scans and Rapid Prototyping and is being developed through Imagination Catalyst, OCAD U's innovation incubator.
- **Feeling 3D.** Haptic Holography, one of 12 university projects funded last year through FedDev Ontario, adopts the premise that existing medical training tools can be made better by integrating holographic overlay and sensory touch. Medical students learning procedures that require extreme precision can breathe a sigh of relief.
- **Chemotherapy made safer.** Inaccurate medical forms kill. OCAD U's Graphic Design program stepped in to redesign pre-printed chemotherapy forms so they would be easier to read and fill out. Eight student volunteers, supervised by OCAD U professors, worked with human factors researchers and a working group of nurses, pharmacists and doctors from across Canada.

"Go right there," he says, pointing to the middle of the mound. "There's nice give and then you'll go through the fat. You can try again if you'd like."

As any physician will tell you, "trying again," is not always an option when working on real patients. Yet it's encouraged when medical students are using one of LeBouthillier's amniocentesis simulators — designed, fabricated and engineered wombs that come complete with a silicone fetus the size of an actual fetus at 24 weeks. The simulator is used to teach invasive perinatal surgery along with amnio procedures. It's also just one of a number of different medical simulators he has developed over the past 10 years for hospitals in Canada, the U.S. and overseas.

"I've watched doctors who are not confident become confident using the amniocentesis model. That's a good thing. A very good thing," he concludes.

Others agree. In 2012, LeBouthillietr joined 22 Ontario university researchers to launch the Council of Ontario Universities' Research Matters campaign. Now he's making use of a year-long sabbatical and Federal Economic Development Agency for Southern Ontario (FedDev Ontario) funding to build a synthetic fetus — complete with soft tissues, bone structures and internal organs — using MRI scans. He's partnering with Javelin Technologies in Oakville, Ont., using highly precise 3D printers and silicone to create the finished product.

LeBouthillier admits it's a huge job, but he's excited about the world of possibilities it could open for medicine, art and design.

"It's a grinding of gears of the left and right hemispheres. I get a lot of mental pleasure out of being able to problem solve," he says. "That's one of the things that OCAD U grads do. They make things that have never been made before." □

With more than 1,000 articles under her belt, Canadians across the country have read Kira Vermond's columns for the *Globe and Mail* and *Chatelaine*, and listened to her career advice on CBC Radio weekday mornings. She has published two non-fiction books with two more to be released in 2013 and 2014. This is her first article for *Sketch*.

Making Digital Matter – Surgical Training Fetus

1

Research Team Lead
Francis LeBouthillier, OCAD University

Researchers

Dr. Mike J. Wiley
Dr. Rory Windrim
Dr. Mike Seed
Damiaan Habets
Greg Phillips
Andrea Zariwny

Abstract:

Medical surgeons need to hone their skills prior to performing high-risk surgical procedures on fetuses in utero and on newborns. To date, highly representational 3-dimensional fetal models, that have life-like physical properties, do not exist. The goal of our research project is to create a series of accurate and responsive fetal models to help surgeons visualize the complex physiology of a newly developing fetus and their associated pathologies. These models will provide surgeons with the visual and tactile information necessary to confidently implement highly complicated fetal surgical procedures.

Research Description:

In collaboration with the University of Toronto's, Division of Anatomy, the Department of Surgery (Wiley), Mount Sinai Hospital's Special Pregnancy Program (Windrim) and the Hospital for Sick Children (Seed) we plan to develop a surgical training fetus using magnetic resonance imaging (MRI) and computed tomography (CT) scan data. This high fidelity 3-dimensional medical model will be manufactured from synthetic materials to accurately represent the tactile and life-like characteristics of the human body. The data derived from MRI/CT scans will be used to create digital forms that will be produced through rapid prototyping technology (Habets, Phillips, Zariwny). We will then employ a complex moulding system to produce a pliable three-dimensional model containing the vital organs, skeletal structures and soft tissues.

Once constructed, the Surgical Training Fetus models will be used to simulate a variety of medical conditions that surgeons could address through laparoscopic and ultrasound-guided surgical procedures in-utero and on newborns. This project will involve extensive research and development in the application of highly specialized software packages that support the creation of three-dimensional models from MRI/CT data.

Some of our key design challenges in this project encompass how to manufacture the fetal models in materials that can be visible within an ultrasound and MR/CT scan environment. Success in this area will enable surgical teams to use crucial visualization tools (MR/CT scans) to guide invasive perinatal surgeries. We are also researching new approaches to manufacturing technology that facilitate the 3-D printing of soft and pliable materials that have characteristics similar to the human body

The Surgical Training Fetus model could be used to address such fetal surgeries as:

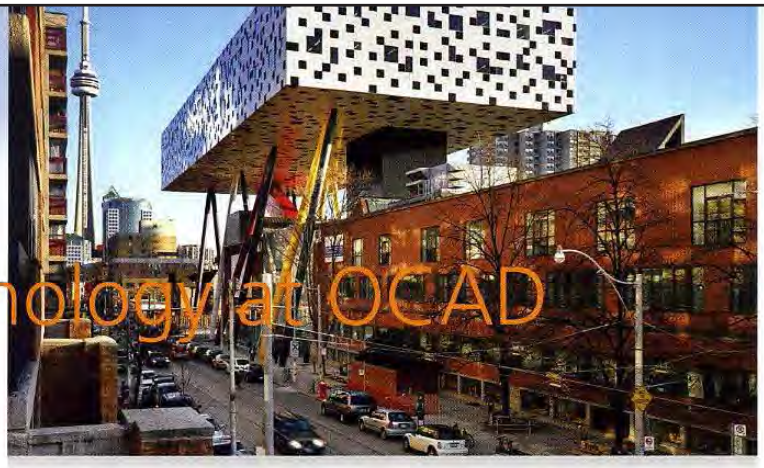
- Fetal Oral Teratoma
- Fetal Bladder Obstructions
- Aortic or Pulmonary Valvuloplasty – opening the aortic or pulmonary fetal heart valves to allow blood flow
- Atrial Septostomy – opening the inter-atrial septum of the fetal heart to allow unrestricted blood flow between the atriums
- Critical Aortic Stenosis – narrowing of the main outlet valve of the left ventricle.
- Congenital Diaphragmatic Hernia – Balloon tracheal occlusion
- Spina Bifida – Fetoscopic closure of the malformation

- Theme 1: Volumetric Visualization for Bioinformatics and Medical Applications

innovation series

THE INTERPLAY OF Art & Technology at OCAD

by **Rob Cornforth**



OCAD's Sharp Centre for Design: A highlight of OCAD's $42.5 million campus redevelopment, The Sharp Centre for Design is a marvel of innovation and architecture. Situated above the older main campus building, it provides OCAD with outdoor park space and reconnects Grange Park with the McCaul Street neighbourhood. Other than being suspended in the sky, it is a very conventional structure (essentially a box), with efficient use of space for classrooms, studios, offices, and student workspace (www.ocad.ca). PHOTO: RICHARD JOHNSON (WWW.INTERIORIMAGES.CA)

The Ontario College of Art & Design (www.ocad.ca) is Canada's self proclaimed "university of the imagination" and is dedicated to art and design education, practice, research and invention across a wide range of disciplines. Founded in 1876, OCAD is among the nation's most cutting edge visual arts and design schools. Programs, such as the Digital Futures Initiative, offer students a cross disciplinary curriculum with opportunities to push the boundaries of artistry and technology.

In both the real and virtual classrooms of OCAD, the interplay of design, art and technology reflects a world where art drives advancements in technology and technology allows for creative processes once never imagined. Technological developments have led to new forms of contemporary media that redefine the nature of art while bolstering the artists' ability to practice and present their work. At one time, photography was not considered an art form yet, over the 20th century, master photographers such as Ansel Adams, Edward Burtynsky, and Henri Cartier-Bresson were undeniably creating contemporary art that had a massive appeal to an emerging audience. Cutting edge technologies are continually adopted by artists who in turn challenge our definition of art. Innovation has been adopted by artists since the dawn of man whether painting cave walls with a concoction of pigments or in the creation of tools with which to paint or sculpt. Presently, the ubiquitous utilization of digital media tools has augmented the analog practice of cutting and pasting images for both professional artists and Rick Mercer Photo Challengers (www.rickmercer.com) alike. The goal of presenting an interesting montage of images has never been easier with technology acting as a tool to develop and share our artistic creations. In turn, art is valued in technology; artists have helped to bridge the interactivity of man and machine by humanizing the tools we rely on every day. Artistry permits a richer tapestry to impart information in the most cutting edge environments whether for medical research or training.

Martha Ladly is a professor in OCAD's Faculty of Design where the most popular media and online virtual environments have been embraced as part of the university's pedagogy. Mobile devices paired with social networking permit accessible lectures and effective collaboration. Ladly teaches in a 3-D virtual classroom through an online application called

▶ Baycrest's Memory-Link program helps patients afflicted with brain trauma or amnesia to develop compensatory skills aided by handheld electronic organizers. OCAD Professors, Ladly, Judith Doyle, and OCAD Virtual Communities student Victor Leung worked with Dr. Brian Richards' team developing memory architectures that prompt with reminders and assist procedural learning. IMAGE COURTESY OF OCAD

▲ OCAD Professor Martha Ladly, Faculty of Design and co-editor of Mobile Nation - explores the social nature of mobility from art and design through to engineering, architecture, and the social sciences.
PHOTO: MARINA DEMPSTER

The Interplay of Art & Technology at OCAD by Rob Cornforth,
Ottawa Life Magazine, February 2009, pp. 24-27.

Second Life. Linden Lab's Second Life is a shared experience where over a million user-created avatars engage a massive virtual world called The Grid (http://secondlife.com/). "Our students really enjoy it," says Ladly, "wherever they are in the world - they may continue to participate with their avatar. The avatars reflect what is important to our students. Their creations are sometimes wild and bizarre, as they can create their own bodies. The virtual space is shared with visitors who can enter the sand box we have built and can then add to the things we have created – virtual guest speakers often visit, as well."

Technologically driven virtual environments assists in artistic development and education while the refinement of 3D environments has become an art form which in turn has been adopted in the use of cutting edge technologies, such as mnemonic devices. Baycrest's Memory-Link program helps patients afflicted with brain trauma or amnesia to develop compensatory skills aided by handheld electronic organizers. Professor Ladly and Judith Doyle, a professor in OCAD's Faculty of Art, worked with Dr. Brian Richards' team developing memory architectures that prompt with reminders and assist procedural learning. "Memory can be supported with mobile devices displaying video reminders... a virtual environment can act as a memory palace filled with a trove of memories," says Ladly.

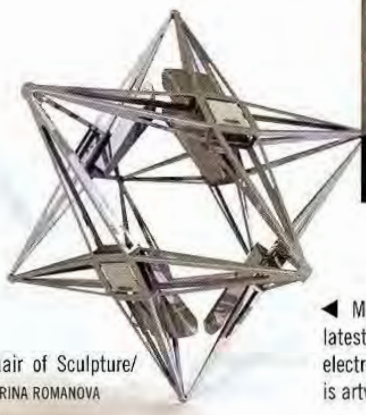
OCAD Professor and Chair of Sculpture/Installation, Francis LeBouthillier creates medical models for the practice of surgical skill development and precision. Part of his task is to guide the hand eye coordination of doctor training through an accurate and realistic experience that can be transferred to real life scenarios. When tactility is vital to simulation – "the issue of getting it right is a complex one," admits LeBouthillier. A rudimentary digital experience like moving a cursor on a screen does not impart the same learning experience as using a needle simulator. Technology combined with artistry allows for greater success in recreating and perfecting simulations. LeBouthillier says, "There is no doubt that technology is a part of the design or artistic practice but one feeds the other. There is always a creative idea that needs to be solved. ..tech informs my art practice."

"OCAD has been offering access to rapid prototyping technology to its students and it is in the process of building new digital labs. I believe OCAD is positioned in a unique place to provide their students with a balanced educational model. This is a model that values the fundamentals inherent within the traditional approaches to art and design and offers access to the new and developing technologies. We are truly in a very challenging and exciting time. As digital technology becomes abundant and readily available, the artist/designer will challenge its limitations and engage and expand its possibilities. I have observed that the creative individual seems to want to reform and reinvent conventions, challenging boundaries and limitations with a critical perspective that has potential to illuminate in a multi -dimensional way," says LeBouthillier.

So do art and design promote advances in technology or does technology drive art and design?
The answer to this question may depend on how you define art.

Matthew Donovan is an OCAD graduate and Artist in Residence at the Measurement and Control Laboratory (www.imrt.ethz.ch/) in Zürich, Switzerland collaborating on projects designed purely for the sake of creating art and to redefine the realm of the possible. Professor Raffaello D'Andrea heads Matt's research lab; together they create non utilitarian engineering projects designed to break artistic constraints. "There is a lot of pressure to engineer for a practical purpose but that is not our motivation. We have freedom - I love building weird projects and Raff loves the pure research." Matt and, fellow collaborator, Hallie Siegel's latest project is called The Balancing Cube - a sheet metal and electronics cube that can be balanced on any of its points. "It is artwork, purely," says Donovan who has,"established a career combining design, art and technology and presenting them as inseparable". Donovan also collaborated on a project called The Robotic Chair (www.roboticchair.com), a realistic looking wooden chair that falls to pieces but has the ability to pull itself together. If that sounds like a metaphor for life, it is; the chair collapses but gets in touch with itself by seeking and reassembling its parts and then raising itself upright again.

▲ OCAD Professor Francis LeBouthillier, Chair of Sculpture/Installation, holding training models PHOTO: MARINA ROMANOVA



◀ Matthew Donovan is an OCAD graduate and Artist in Residence at the Measurement and Control Laboratory (www.imrt.ethz.ch/) in Zürich, Switzerland

◀ Mathew Donovan and, fellow collaborator, Hallie Siegel's latest project is called The Balancing Cube - a sheet metal and electronics cube –that can be balanced on any of its points. "It is artwork, purely," says Donovan. PHOTO: MATHEW DONOVAN

From arts to sciences

By Sean Kelly Keenan

PHOTOGRAPH MARINA DEMPSTER

WHO: Francis LeBouthillier
WHAT: Chair of Sculpture and Installation Ontario College of Art and Design (OCAD)

TO SAY THAT Francis LeBouthillier is a talented man would be kind of like saying that Mozart wasn't half bad at the whole music thing. His body of work as an artist is astounding in its range. From his highly provocative and award-winning video installation pieces, to the incredibly detailed lines on the statues he created as part of the Chinese Railroad Workers memorial commissioned by Eldon Garnet, the depth of knowledge and precision of technique he exhibits in a multitude of media is breathtaking. Looking at the skills breakdown he lists on his website at www.francislebouthillier.com, it's hard to imagine what else the 49-year-old chair of sculpture and installation at the Ontario College of Art and Design has left to master. From traditional art methods like life modelling, foundry work, metal- and woodworking, through to newer mediums such as computer art, video and photography, LeBouthillier's abilities appear to have no bound. Yet it's what he's doing with them that makes him really interesting.

For the past 17 years, while continuing to create and expand the scope of his own artistic expression, LeBouthillier has been using his skills and insight to help guide others on their own artistic journeys in his role as a teacher. Along with aiding in the development of his students' technical abilities, LeBouthillier tries to stretch their creative boundaries as well, urging them to constantly question and challenge conventions. For him, art is a language, after all, and a language needs to be accessible — to be read and spoken and heard — in order to be relevant. To that end, LeBouthillier encourages his students to connect using whatever media speaks to the people, whether through video, radio or even just getting an ideals-challenging haircut.

Moreover, for the past decade, Lebouthillier has also been putting his gifts to good use in another field of study: medicine. Using traditional bronze-casting techniques, LeBouthillier crafts hollow-cored silicon fetuses for use in the training of medical students. The models are ridiculously detailed, from the way they move down to the sutures on their heads. The initial models were (and still are) for use in birthing simulators (and they are pretty amazing). What he's been working on over the past two years though is even more so: models for use in in utero surgery simulators. Photos taken from a recent test run at Mount Sinai Hospital are phenomenally realistic looking. (LeBouthillier even built one of the models with a life-like trachea inside.) Once perfected, they'll help doctors and med students practice in-womb surgery procedures, such as one used to correct spina bifida before the damage is done. Next up after that, LeBouthillier is hoping to go all the way with the project, eventually making models with a complete set of internal organs.

LeBouthillier truly is doing some very remarkable stuff in the arts — and now in the sciences too.

From Arts to Sciences: by Sean Kelly Keenan EYEWEEKLY (newspaper) June, 3 2009

'If people aren't included, they contribute less. This ultimately lowers the quality of life for everyone.'

DESIGNERS NEEDED FOR BRAIN IMPLANTS: HEALTH CARE AND INCLUSIVE DESIGN

by Leanna McLennan

ABOVE
OCAD STUDENT MIKE MONIZE SPEAKS AT THE DESIGN COMPETITION AWARDS CEREMONY
PHOTO BY LINO RAGNO

PG7

"I couldn't go into a lot of places in my wheelchair because there [would be] a foot-high step," says Mike Monize, a third-year industrial design student at OCAD. "So I decided to go into design at OCAD to improve the quality of life for myself and other wheelchair users.

"If people aren't included, they contribute less. This ultimately lowers the quality of life for everyone."

To address accessibility issues, Monize recommends what he calls "socio-ergonomics" as the methodology for OCAD's annual design competition, defining it as "an ethos grounded in designing, with an understanding of difference and equality; an acknowledgement of our interconnection with one another and our surroundings; and a sense of responsibility to produce effects that foster life."

This year's competition — Design for Humanity: Access for All — challenged students to explore connections between design and health care. OCAD worked in partnership with the March of Dimes and the Toronto Rehabilitation Institute (Toronto Rehab), a specialized teaching hospital of the University of Toronto.

"The relationship between design and health care is an under-explored area that could be the key to developing the prosperity of the Ontario economy," notes Graham Hufton, a Faculty of Design instructor at OCAD and the senior industrial designer at Toronto Rehab.

In Ontario, health-care research is a thriving field. The U of T and its affiliated hospitals are second only to Harvard University in terms of the number of medicine-related scientific publications they've produced. They also spend more than $500 million in medical research each year.

OCAD too is creating opportunities in this arena, including internships and research possibilities at institutions such as Toronto Rehab and the Baycrest Centre for Geriatric Care. It's a move that underscores the increasingly significant role of designers in health-care research.

Indeed, the theme of this year's competition reflects an even broader move at OCAD towards universal, inclusive design, rather than design that requires adaptation to make it universally accessible.

"Design for humanity, which is the philosophical base of our design programs, focuses on ethical, inclusive and sustainable design," says Doreen Balabanoff, Assistant Dean of the Faculty of Design. "This involves thinking and creating thoughtfully by looking at design issues from multiple perspectives."

Instead of adding ramps onto buildings as an afterthought, for example, universal design aims to create things that everyone can use. In this view, good design is inclusive design. OCAD's strategic plan and curriculum development will ensure that students graduate with a specific skill set that allows them to create good design.

The principles of universal design are integrated into first-year Design Practices courses. They're also the focus of the advanced-level course, Universal Design: Principles and Practices, taught by Howard Gerry, an associate professor in the Faculty of Design. According to the course syllabus, "designers are challenged to recognize the *diversity* of possible end users and their various needs,

2008 Designers Needed for Brain Implants: Health Care & Inclusive Design
By Leanna McLennan, Sketch Magazine, Spring 2008, pg 7-9.

ABOVE
MODEL OF A
24-WEEK OLD BABY
FOR AMNIOCENTESIS
SIMULATOR MODEL
BY FRANCIS LEBOUTHILLIER
PHOTO, COURTESY
OF THE ARTIST

TOP
EARLY TESTING OF
AMNIOCENTESIS
PROTOTYPE BY FRANCIS
LEBOUTHILLIER
PHOTO, COURTESY
OF THE ARTIST

ABOVE
FRANCIS LEBOUTHILLIER
WITH HIS TRAINING MODELS
PHOTO BY MARINA ROMANOVA

whether related to age, size, physical mobility or visual/mental abilities."

"Disability is part of diversity and needs to be integrated into OCAD culture and curriculum," notes Cathy Berry, Learning Strategist at OCAD's Centre for Students with Disabilities. "The design competition brought disability into the conversation. It was a wonderful starting point."

Defining disability is complex. Many disabled people want to have their disabilities recognized as an integral part of themselves. Thus, some suggest a shift in language — from "people with disabilities" to "disabled people."

According to Berry, at OCAD some of the predominant disabilities are cognitive and are therefore related to learning. Designing for people of all abilities is a way of bringing both visible and invisible disabilities into the conversation without setting disabled people apart.

This year's design competition fostered an awareness of disability issues and allowed participants to engage with them in a tactile way.

The winning team — Lesley Look Hong, Emily Oppenheim, Finlay Paterson, and Steve Reaume — designed a wayfinding system called Pathways. As part of their design process, they walked around the school, thinking of how someone in a wheelchair would be able to get around, and making mental maps of things to change. They addressed cognitive disabilities by making their instructions for navigating the campus easily accessible to people with different learning styles.

"We tried to make a space that works for everybody, to make design that has the concept of access integrated into it," says Reaume.

The key design component of Pathways, which aimed to produce a sense of campus unification and proposed to make travelling on campus easier for everyone, was the enhancement of sensory perception: sight, touch and sound. The team recommended textured floors, so that vision-impaired people could feel shifts beneath their feet. They also designed information kiosks with visual and voice prompts, and used colour coding for OCAD departments.

"It was the best thing of the entire year," says Look Hong. "We were able to implement the design process. This allowed us to see the gaps in our knowledge and strengthen our skills."

Toronto Rehab, a partner in the 2008 design competition and a world leader in assistive and rehabilitation technology, is an example of the kind of institution OCAD is partnering with to create more opportunities in the field of health and wellness. One OCAD student is currently interning at Toronto Rehab, which makes industrial designers a key part of research teams, along with academics, nurses, physiotherapists, doctors, business people and engineers.

"This is quite unusual in university academic research," notes Geoff Fernie, Vice President of Research at Toronto Rehab and a professor in the Department of Surgery at the U of T.

The standard practice in universities is for researchers to invent something and then send it to a technology transfer agency, which markets it to a corporation. Toronto Rehab takes a different approach: it works directly with industry partners to get products to market. This allows people to pool their talents and work together as an integrated team.

"The path to developing and commercializing a product is expensive, and we try to make the interface as affordable as possible," says Fernie. "One of the key components of this is to include industrial designers because they have a way of thinking about functionality. The researchers come up with great concepts. Industrial designers have a lot to contribute to make a product usable. affordable and attractive — that is, non-stigmatizing."

Fernie has reinvigorated his interest in OCAD and its students due to the university's renewed emphasis on fundamental design skills, such as hand skills.

ABOVE
FIRST PLACE IN THE OCAD DESIGN COMPETITION WENT TO TEAM 9 FOR "PATHWAYS," A FULLY ACCESSIBLE WAYFINDING CONCEPT FOR OCAD

TOP, RIGHT
SECOND-PLACE WENT TO TEAM 5 (JONG JUNG LEE, KI HO LEE, SEAN LEE, CHRISTINE LIEU AND MINSU KIM) FOR THE CONCEPT "EXITGLOW," WHICH ADDRESSED EMERGENCY EVACUATION PROCEDURES.

ABOVE, RIGHT
TEAM 1 (GREG CROSSLEY, ELAINE MACARANAS, ROBIN MCFAUL AND JOSHUA MORAES) RECEIVED AN HONOURABLE MENTION FOR THE CONCEPT "SEES: STANDARDIZED EMERGENCY EVACUATION STRATEGY."

"Until you can translate an idea o something that's tangible — mething you touch, feel, swallow, ite on, wear or implant — no one n assess its value and no one will rest in it," Fernie notes. "OCAD udents work better in our context cause they understand that we ed solid progress to turn ideas into arketable products.
"That doesn't mean we want to nibit creativity in any way — far m it. It just needs to be real. We've t people with real problems that ed to be solved quickly."
Now more than ever, industrial sign students have the capacity help. Says Julian Goss, Chair of dustrial Design at OCAD, "We've en working in ID on rebalancing ft' design skills, such as research thodologies, strategic approach d concept development, with an ility to articulate and output these o measurable experience and proyping. This balance is emblematic our great strengths as an art and sign university."
Leslie Beard, the OCAD design dent currently interning at Toronto hab, is designing mobility devices. The institute's new research lab, the largest in scope and size in the world, will allow for more detailed testing of such devices. For example, researchers will be able to reproduce sleet conditions and test how people walk in those conditions.

"At Toronto Rehab, I've seen what I learned at OCAD come to life," says Beard. "It's been a real eye-opener. You see what people go through and what they need. I don't think you can design something efficiently unless you really understand the needs of the people who will be using it."

Practising artists are also using their technical skills to work in tandem with medical professionals. Who would have thought bronze-casting techniques could help create medical simulators? But this is precisely what's being done by Francis Lebouthillier, Chair of Sculpture/Installation at OCAD. Lebouthillier, who started his career in figurative sculpture and later added performance and video to his repertoire, now produces silicone models of fetuses and pregnant women's bellies for medical professionals to use as learning aids.

"Having the technical skills required for mould making and bronze casting has been integral to developing medical simulations," says Lebouthillier, "I use bronze-casting techniques to create the silicone fetuses."

While he is now working with a team to secure funding that will allow him to use rapid prototyping technology, he'll still be finishing the simulators in the studio. "Without the presence of the hand in the making process, something is missing," he says.

His work is particularly useful because he can manipulate silicone to create layers that are comparable, in terms of density, to human tissue. This allows medical professionals to note differences in density when they practice giving needles for amniocentesis, a procedure that requires them to rely on the feel of the tissue.

In the process, Lebouthillier has even learned how to deliver a baby. (Uncannier still, one of his earliest figurative sculptures was of a baby delivering itself.)

As shown by the innovative work of OCAD students and faculty members, the interactions among artists, designers and health professionals will play a vital role in the future of health-care research and real-world applications.

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Leanna McLennan is a Maritime-born writer and academic. Her work has been published in *The Antigonish Review, Broken Pencil, Fiddlehead, Taddle Creek* and *Third Floor Lounge: An Anthology from the Banff Centre for the Arts Writing Studio, 2004.*