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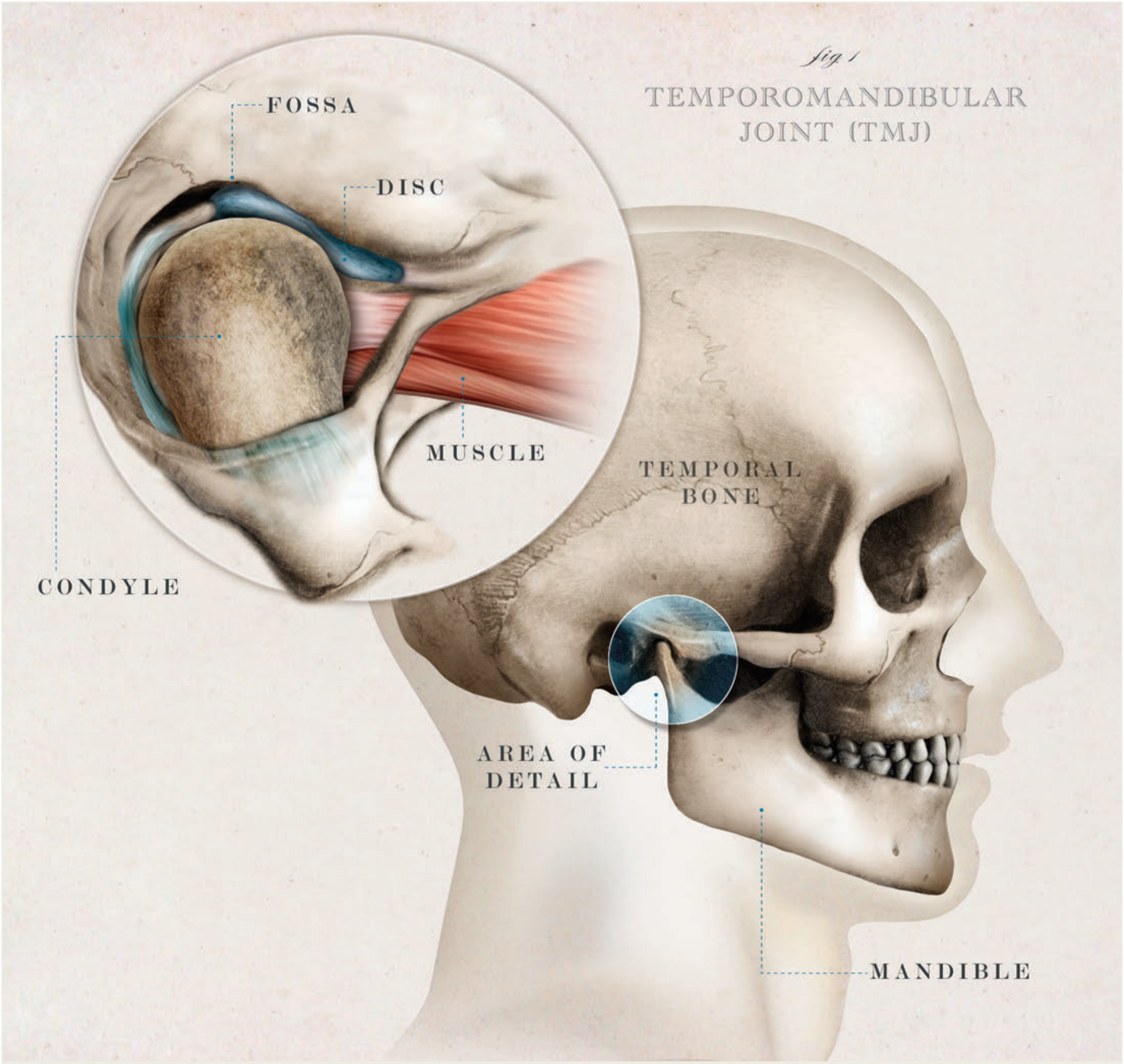
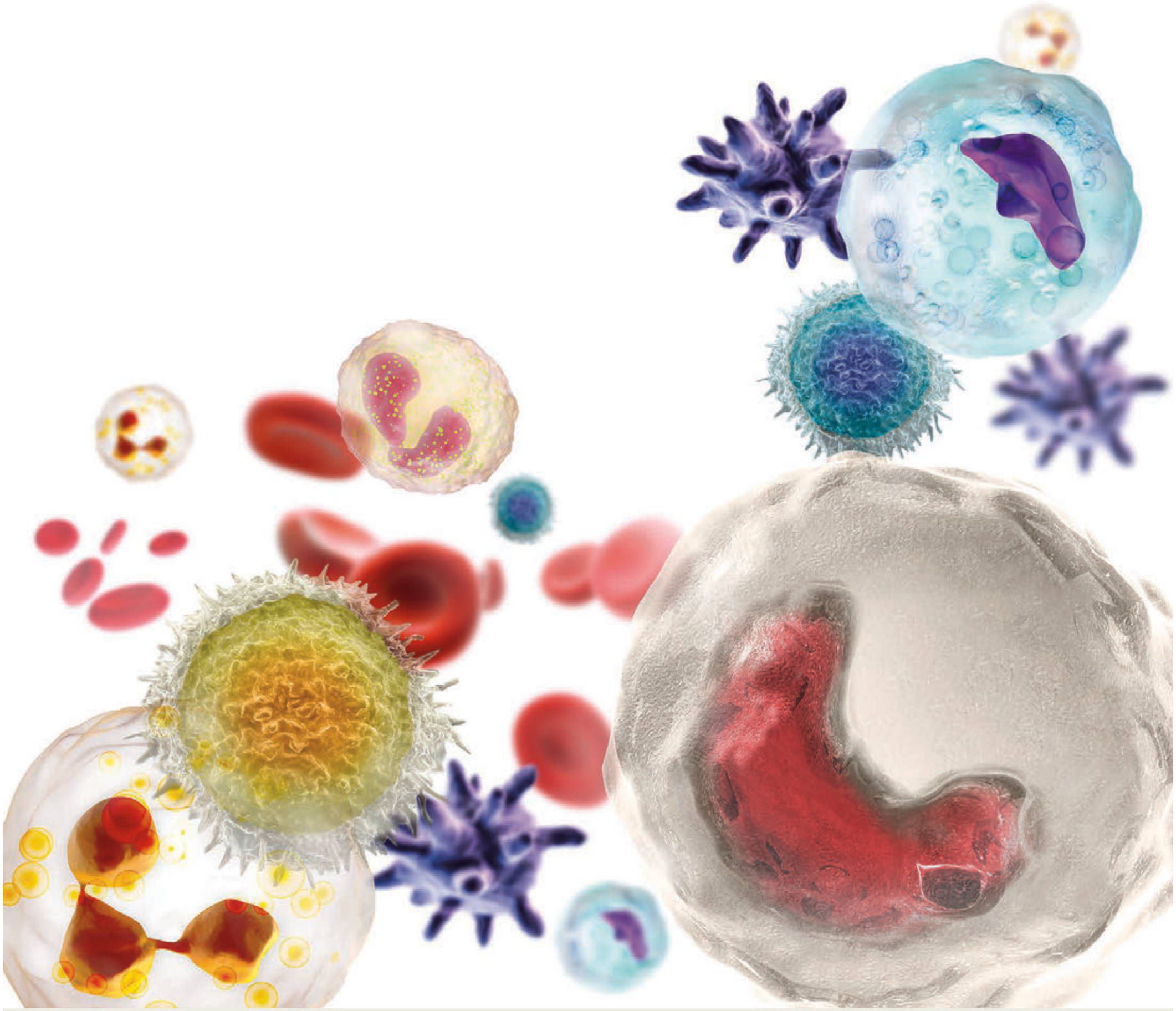


client: The Wise Group | *topic:* TMJ



client: Nationwide Childrens Hospital, *Pediatrics Nationwide* magazine | *topic:* Understanding how the immune system responds to sepsis

Robot-assisted minimally invasive surgery

Minimally invasive 3-D robotics technology enables surgeons to perform operations with just a few small incisions instead of through open surgery, resulting in less pain and a shorter recovery. Approved in 2000 by the Food and Drug Administration, the da Vinci Surgery System was the first to be used for general laparoscopic surgery. Nationwide Children's Hospital is one of nearly 1,400 hospitals in the nation that utilizes the technology.

Surgical applications

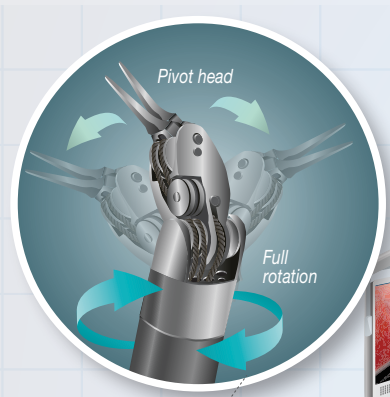
Surgeons at Nationwide Children's use the robotic equipment to perform a range of procedures in urology and general surgery, including operations to treat such problems as urinary reflux, birth defects in the urinary tract, kidney disease, Crohn's disease and appendicitis.

Vision cart

The vision cart is the hub for various parts of the surgical system. The consoles, robotic arms and monitors in the operating room feed into the vision cart, which connects to a central computer system that collects data on instrumentation and surgeons' movements.

The da Vinci system

The system at Nationwide Children's has four arms, three used to guide instruments at the surgical site (A) and one for positioning a camera (C) with two lenses that gives surgeons full stereoscopic vision from the console.



Robotic hands

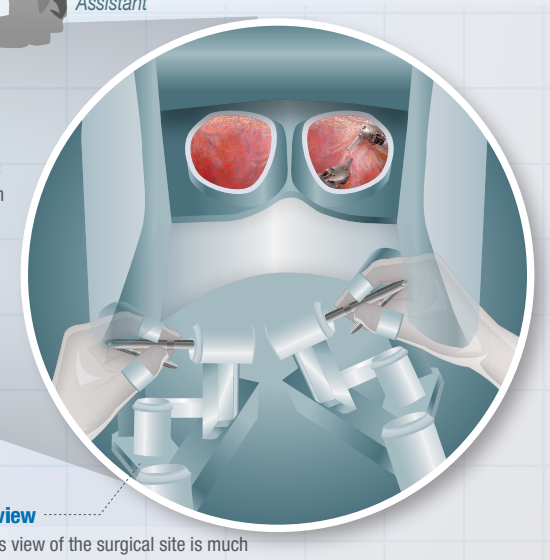
The robotic arms bend and twist just like human hands and wrists—only steadier—and allow surgeons to place sutures that are far more difficult to do in traditional laparoscopy.

Anesthesiologist

Control console

The surgeon sits at a control console just a few feet away from the operating table, using two joystick-like controls and foot pedals to control the instruments and camera held by the robotic arms. The arms remain locked until the surgeon places his head in the viewfinder on the control console. The system translates the surgeon's movement of the controls into smaller, more precise movements by the robotic arms.

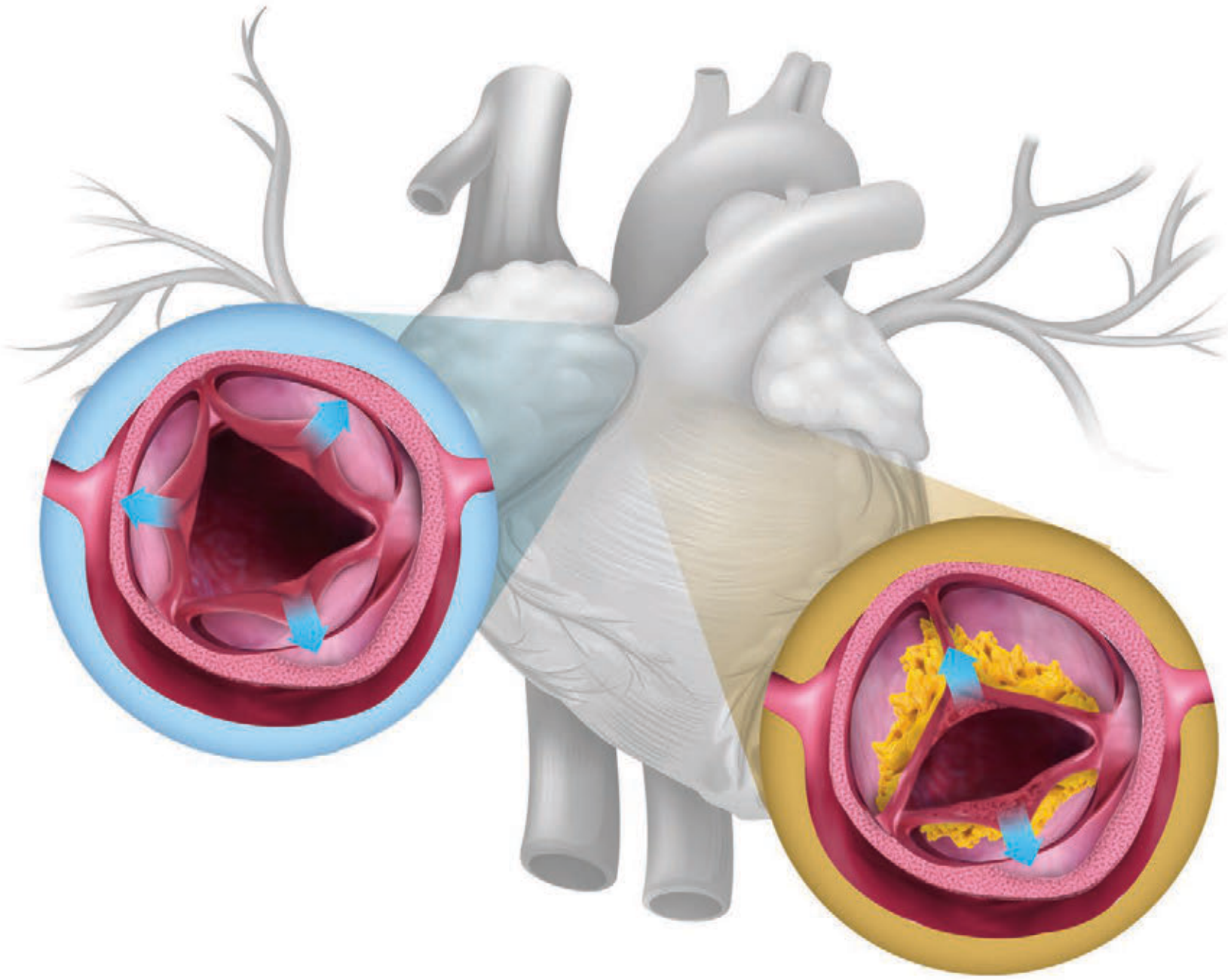
Surgeon at operative console



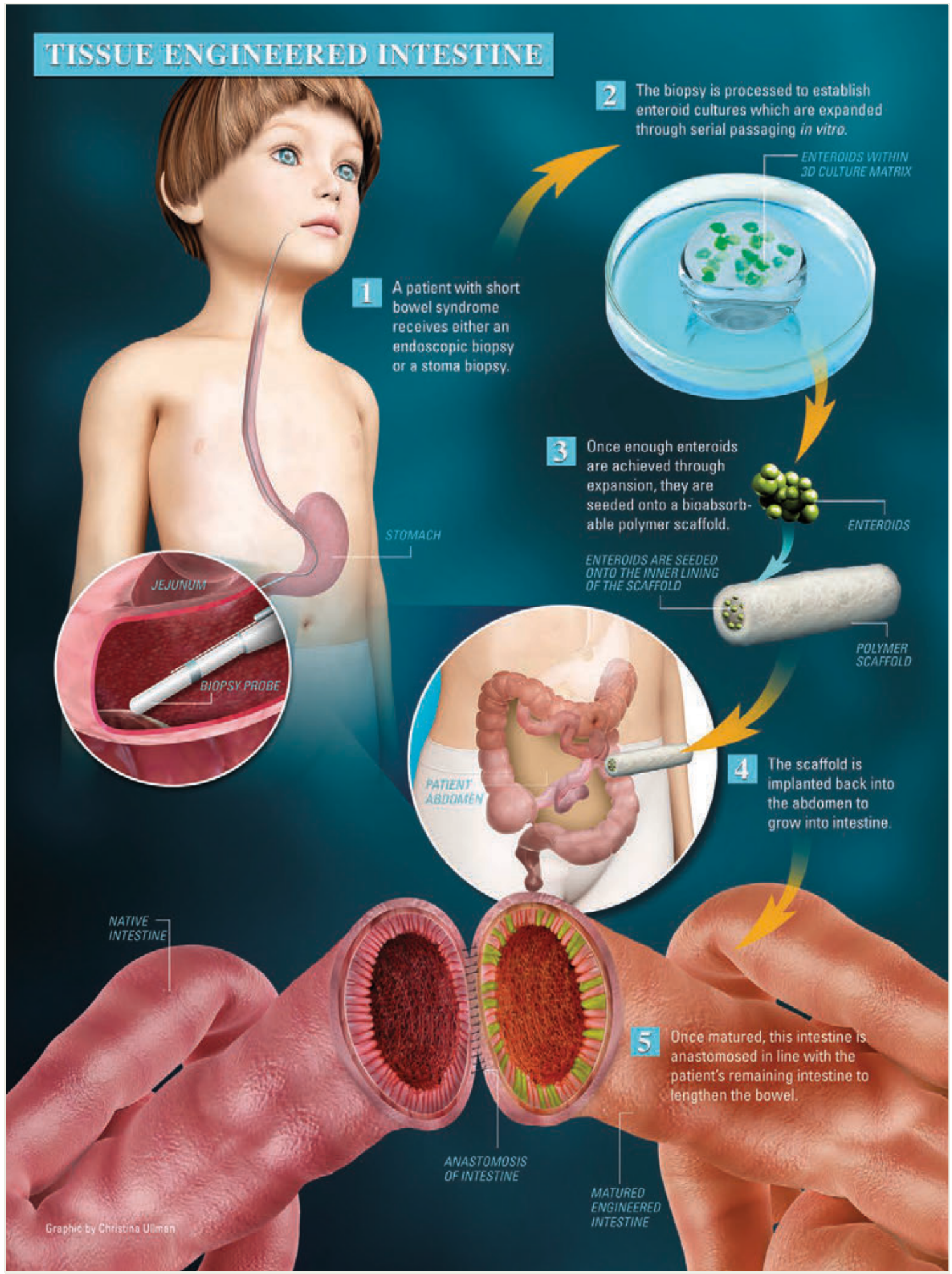
Magnified view

The surgeon's view of the surgical site is much closer than human vision allows, thanks to a 3-D vision system built into the console.

client: Nationwide Children's Hospital | topic: Robot-assisted minimally invasive surgery



client: Nationwide Childrens Hospital, *Pediatrics Nationwide* magazine | *topic*: Coronary heart disease



client: Nationwide Childrens Hospital, Dr. Gail Besner | *topic:* Tissue engineered intestine in pediatric patients

Fighting Sepsis Infection

Oregon State researchers use microchannel technology to treat sepsis. This form of blood poisoning causes the immune system to overreact and can lead to multiple organ failure.

HOW SEPSIS DEVELOPS

Sepsis stems from the immune system's response to a serious infection. It causes systemic inflammatory response syndrome (SI RS). This occurs when chemicals released into the bloodstream to fight the infection trigger inflammation throughout the body.

1 Sepsis results from the immune system's response to bacterial infection.

White blood cell

Infectious Bacteria

Endotoxins

Bacteria fragments

2 In the blood stream, bacterial fragments and endotoxins continue to circulate.

3 In response to endotoxins, the immune response can overreact, leading to blood clots.

Blood clot

4 Antibiotics often don't work on bacterial fragments, which are not living cells.

Bacteria fragments

HOW OREGON STATE RESEARCHERS TREAT SEPSIS

Oregon State researchers have developed a device that processes blood outside the body. It removes bacterial fragments and endotoxins and prevents blood clots from forming.

5 Infected blood from the patient is pumped through the device.

6 As blood flows through microchannels, red blood cells migrate to the center of the channel while bacterial fragments and endotoxins are pushed toward the channel wall.

Captured bacteria

7 Tiny chemical strands attached to the channel walls snag bacteria and endotoxins and remove them from the blood.

Blood flows through thousands of microchannels in the OSU device.

Bioactive coating inside a microchannel

8 The treated blood is transferred back into the patient.

Bacterial fragments and endotoxins in blood

Blood pumped out of the body

Patient transfusion

Graphic by: Christina Ullman, Ullman Design

client: Oregon State University, *Terra* magazine | topic: Fighting Sepsis Infection

Immune function

INNATE IMMUNE SYSTEM

The innate immune system is the body's first line of defense, comprising the cells and mechanisms that recognize and respond to bacteria, viruses and other pathogens.

1 When foreign pathogens enter the body, the immune system recruits phagocytes such as monocytes and neutrophils to fight them.

2 The macrophage engulfs the pathogens and kills them.

3 The pathogens are broken down into pieces inside the cell.

4 The remains are displayed on the cell's surface with the aid of a class of receptors that include Human Leukocyte Antigen (HLA)-DR. A pro-inflammatory cytokine is secreted to help stimulate the immune system to fight the infection.

Macrophage

Monocytes mature into macrophages

Monocyte

Cytokines

Neutrophil

Anibodies

Blood stream

client: Nationwide Children's Hospital | topic: Immune function: Innate

ADAPTIVE IMMUNE SYSTEM

Unlike the innate immune system, the adaptive system almost always requires the detection of a specific antigen to switch itself on. If the monoctyes don't display these pieces of antigen on their cell surface, the adaptive systems stays off.

The cells of the adaptive immune system are called lymphocytes. The two primary types, B cells and T cells, carry receptor molecules that recognize specific targets.

B cell

B cell receptor

Activated B cell

5 Activated B cells secrete antibody molecules that bind to antigens and destroy the invader or mark it for attack by other cells.

Memory B cell

Memory T cell

Antibodies are created that bind specifically to the foreign antigens.

B cells and T cells spawn memory cells that recognize and eliminate previously encountered pathogens.

Infected cell displaying antigen

T cell

6 Cytotoxic T cells recognize their targets by binding to antigen present on the surface. Individual T cells are able to recognize only certain antigens that match their type of receptor.

Infected cell being destroyed

7 The cytotoxic T cells destroy infected cells by releasing cytotoxins and a protein called perforin and cytotoxins. Perforin makes a hole in the membrane of the infected cell. The cytotoxins enter the cell through this hole and destroy the cell and the pathogen inside.

client: Nationwide Children's Hospital | topic: Immune function: Adaptive

Restoring Normal Habits

Sacral nerve stimulation helps school-age and teenage children control urinary incontinence and fecal soiling.

Sacral nerve stimulation is a new treatment that helps control urinary incontinence and fecal soiling. For some children, the nerves that control urination and bowel movements do not work correctly. The SNS unit consists of a small, safe battery and wire under the skin and sends signals to the sacral nerve. The signals help restore normal function and prevent accidents. SNS can be used on school-age and teenage children after other treatments have failed. If the medical team determines SNS is appropriate treatment, a two-part procedure is required to place the SNS unit under the skin.

Benefits of SNS

- Hold in urine
- Urinate fewer times a day
- Stop urine from leaking during the day
- Hold in bowel movements
- Relieve constipation
- Do normal, everyday activities
- Wear normal underwear
- Have more confidence

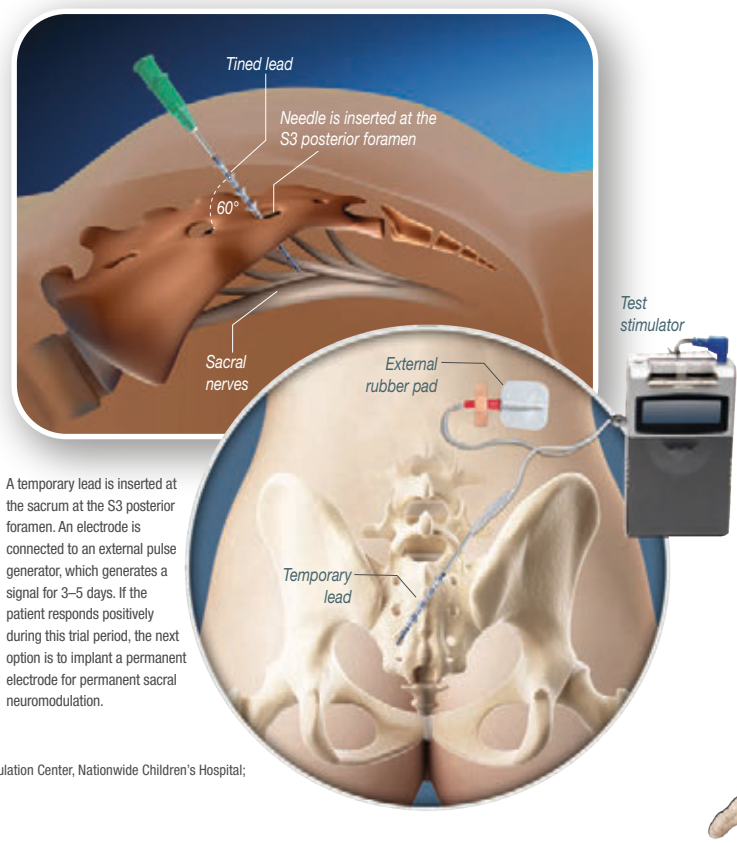
SNS and Pediatrics

In the United States, **several hundred** pediatric patients have undergone sacral neuro-modulation for bladder and/or bowel control.

Since 2012, Nationwide Children's Hospital has performed **more than 60** of these procedures in pediatric patients.

1 The Trial Stimulator

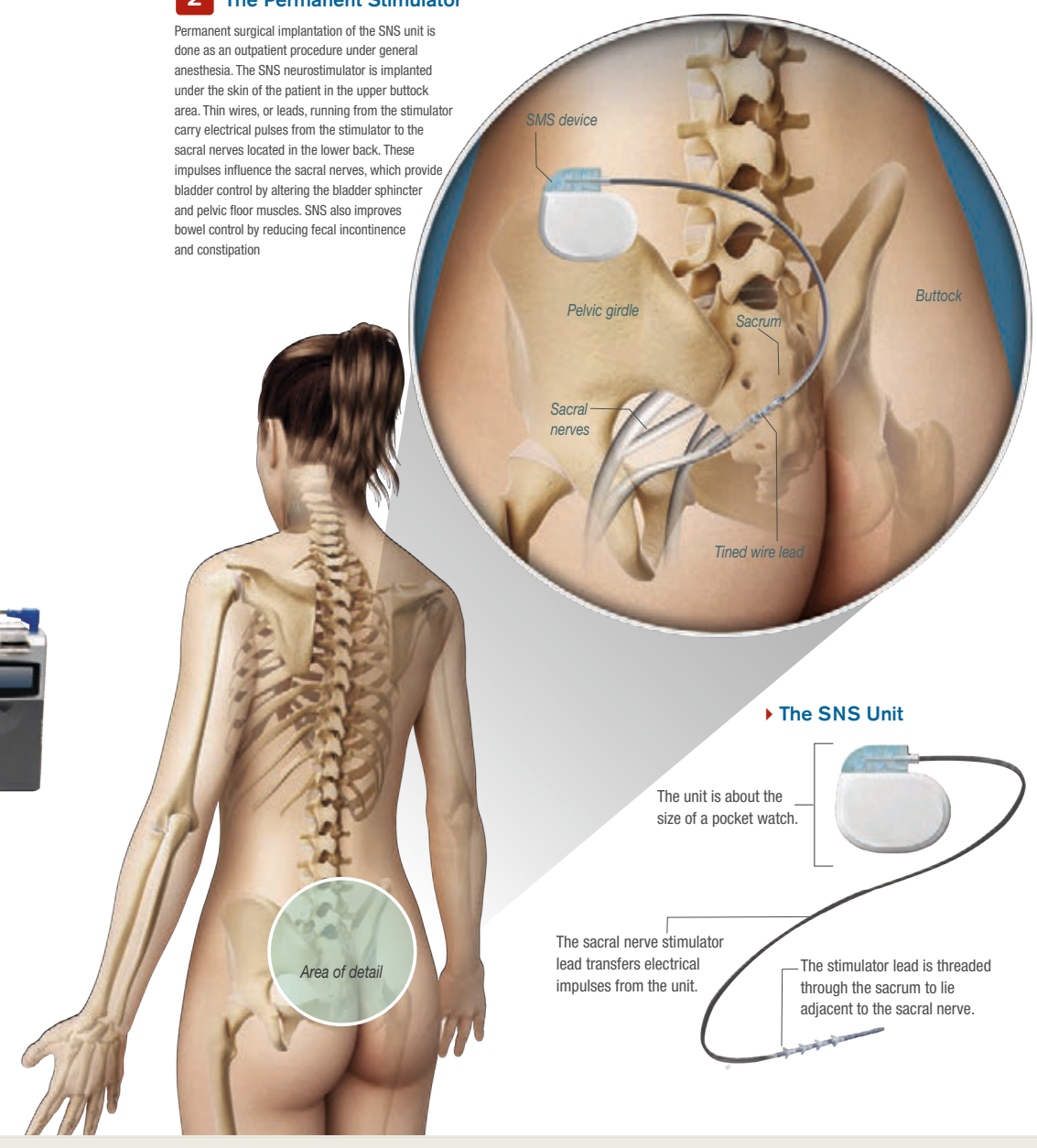
First, the physician/surgeon performs a trial to ensure SNS will work for the patient before placing a permanent stimulator. This procedure is done in an outpatient surgery under general anesthesia along with local anesthesia for additional pain control.



A temporary lead is inserted at the sacrum at the S3 posterior foramen. An electrode is connected to an external pulse generator, which generates a signal for 3–5 days. If the patient responds positively during this trial period, the next option is to implant a permanent electrode for permanent sacral neuromodulation.

2 The Permanent Stimulator

Permanent surgical implantation of the SNS unit is done as an outpatient procedure under general anesthesia. The SNS neurostimulator is implanted under the skin of the patient in the upper buttock area. Thin wires, or leads, running from the stimulator carry electrical pulses from the stimulator to the sacral nerves located in the lower back. These impulses influence the sacral nerves, which provide bladder control by altering the bladder sphincter and pelvic floor muscles. SNS also improves bowel control by reducing fecal incontinence and constipation



The SNS Unit

Sources: Seth A. Alpert, MD, Surgical Neuromodulation Center, Nationwide Children's Hospital; InterStim sales analysis, 2013

Graphic by: Christina Ullman, Ullman Design

client: Nationwide Childrens Hospital, *Pediatrics Nationwide* magazine | topic: Sacral nerve stimulation

One powerful protein

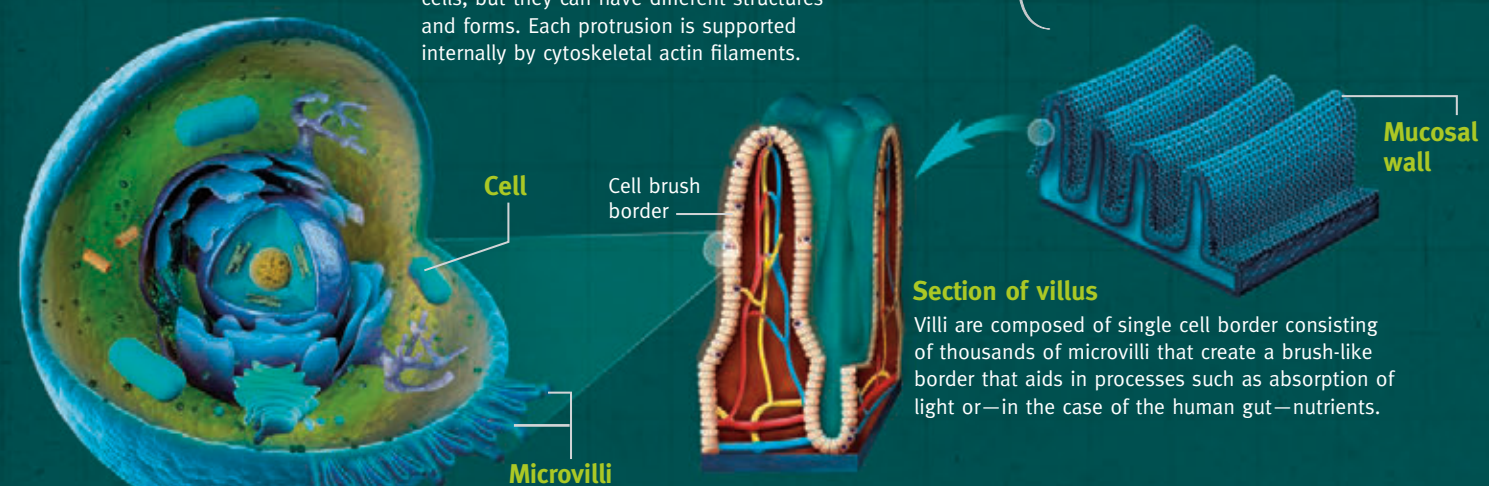
It can impact hearing, cancer, wound healing and more

story by :: **PHILIP BARNES**

A protein called CLIC5 plays an important role in triggering disease and cancer. Ohio University scientists Mark Berryman and Soichi Tanda are studying CLIC5 in two models: the microvilli of the eye cells of fruit flies and the stereocilia in the inner ear of genetically modified mice that are deaf and have difficulty with spatial orientation.

Cell brush border

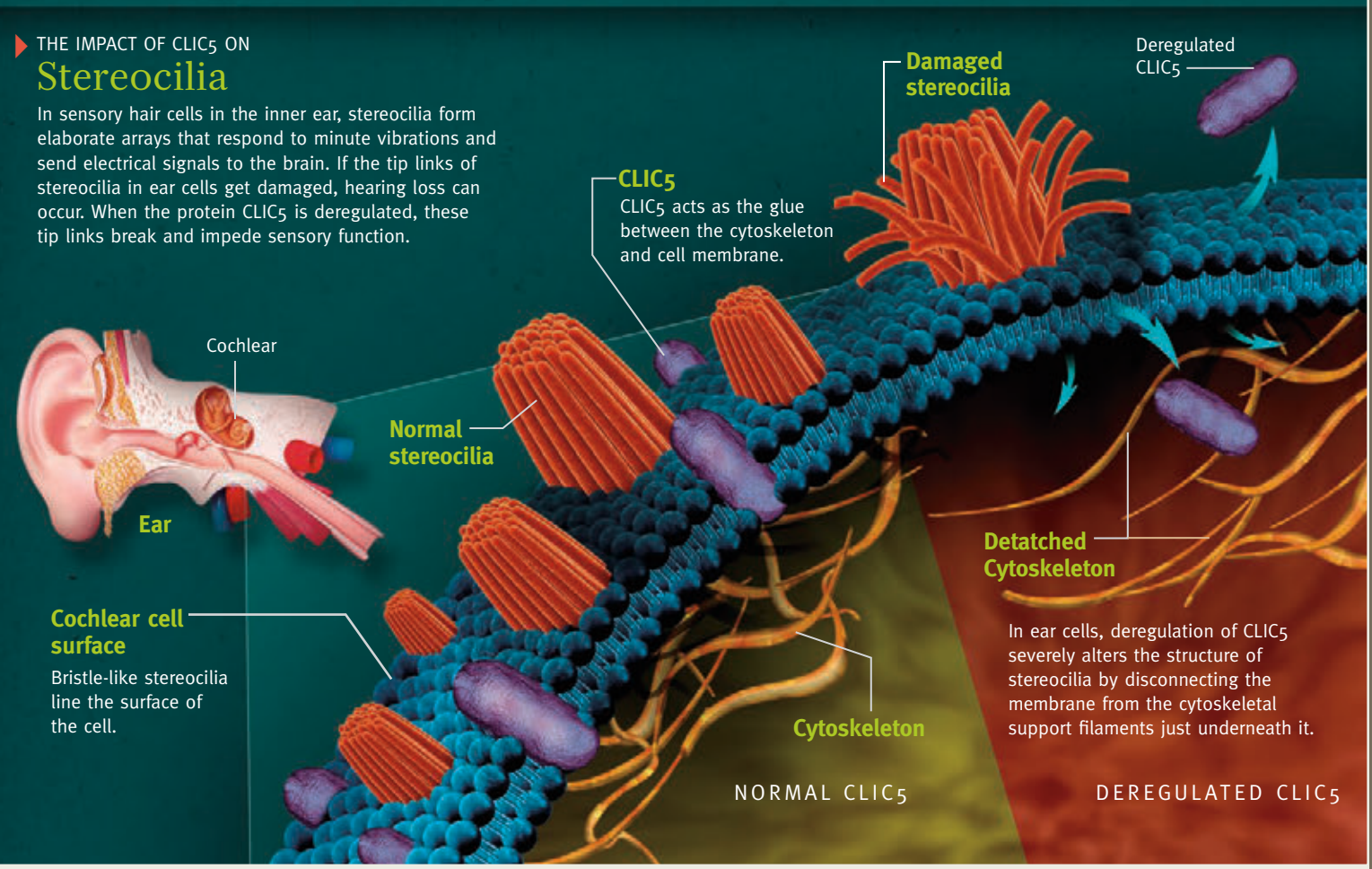
Both microvilli and stereocilia are tiny finger-like protrusions on the surface of cells, but they can have different structures and forms. Each protrusion is supported internally by cytoskeletal actin filaments.



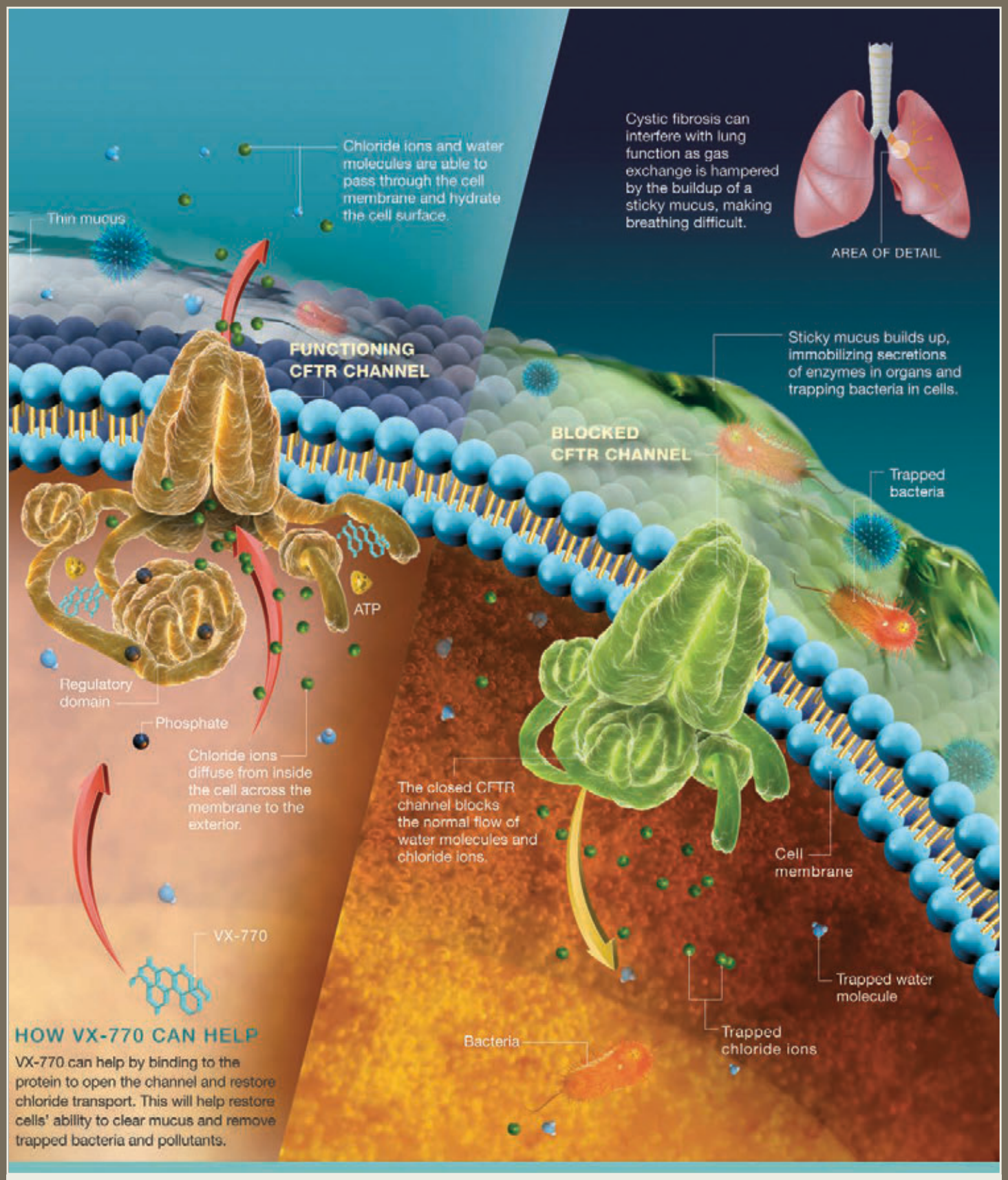
THE IMPACT OF CLIC5 ON

Stereocilia

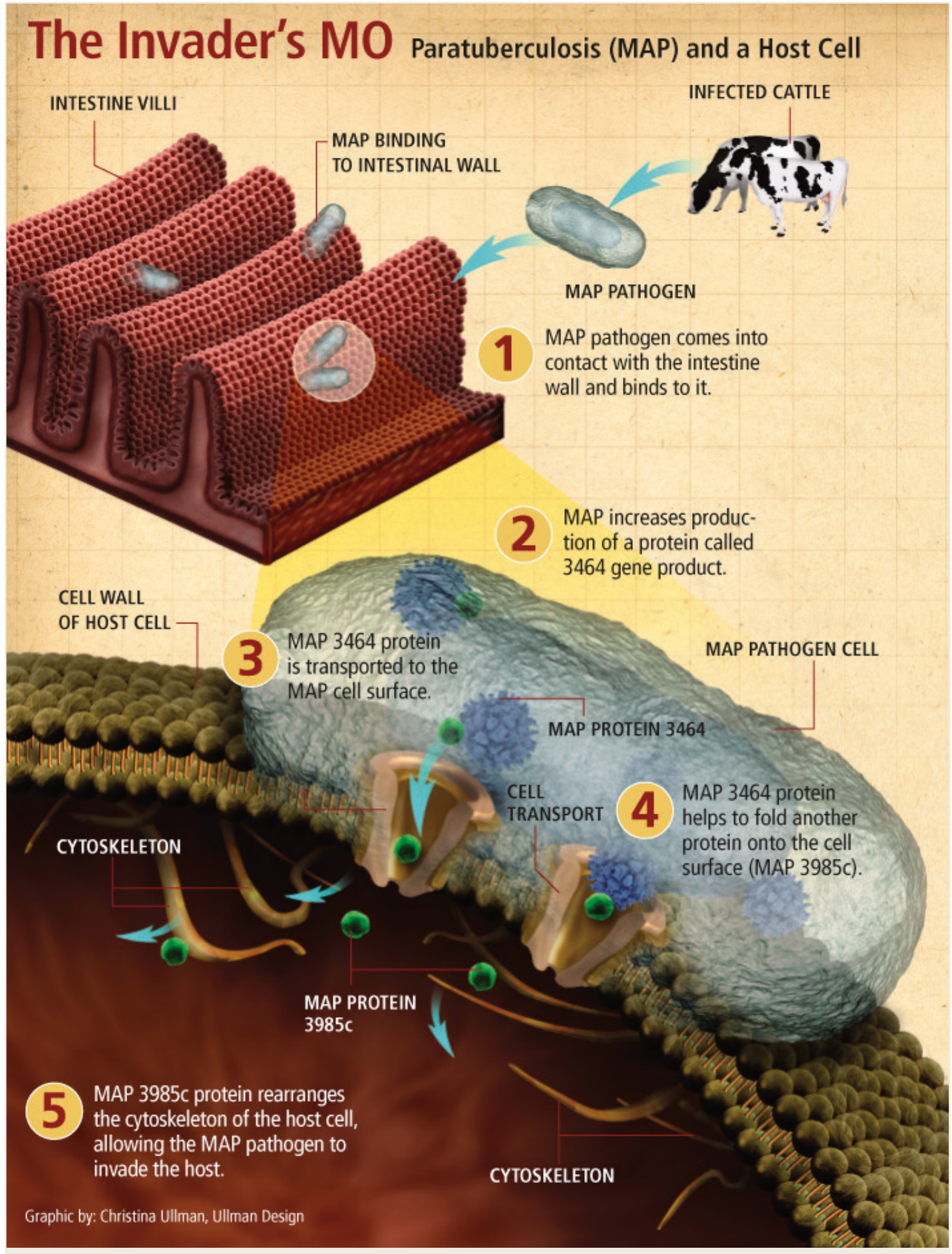
In sensory hair cells in the inner ear, stereocilia form elaborate arrays that respond to minute vibrations and send electrical signals to the brain. If the tip links of stereocilia in ear cells get damaged, hearing loss can occur. When the protein CLIC5 is deregulated, these tip links break and impede sensory function.



client: Ohio University, *Perspectives* magazine | topic: Protein CLIC5



client: Cincinnati Children's Hospital Foundation, Annual Report 2011 | *topic:* Cystic fibrosis

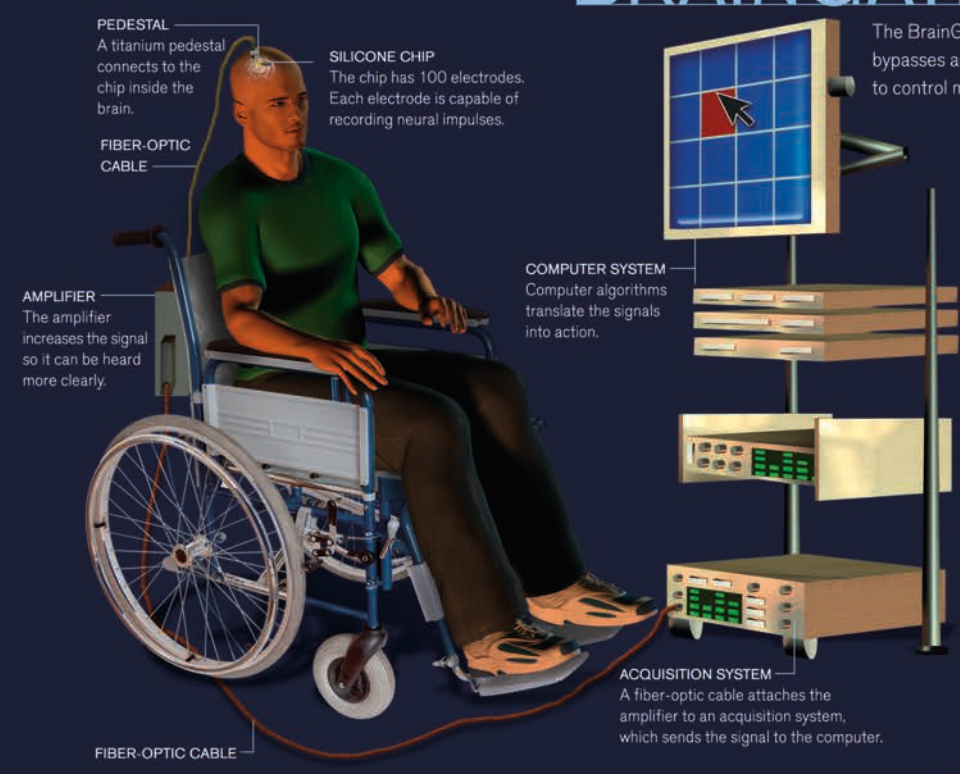


client: Oregon State University, *Terra* magazine | topic: Johne's Disease

Graphic by Christina Ullman

BRAINGATE HOW IT WORKS

The BrainGate system relies on a brain-computer interface that bypasses an injured spinal cord or motor neurons, enabling a person to control movements of a computer cursor through thought.



1 The person thinks about moving the computer cursor. Electrodes on a silicone chip implanted into the person's brain detect neural activity from an array of neural impulses in the brain's motor cortex.

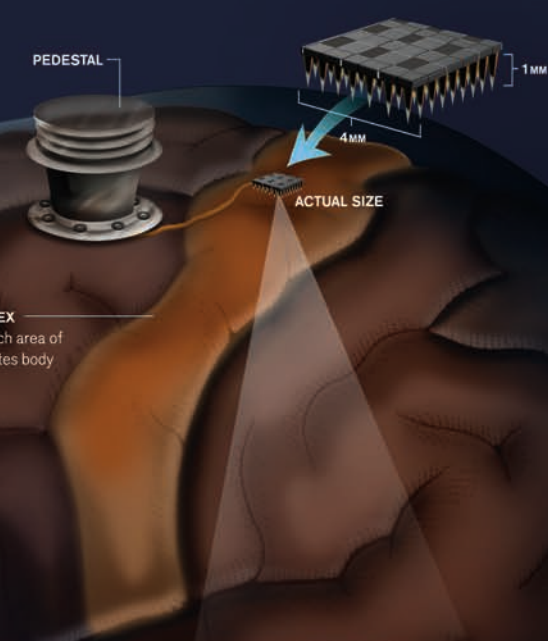
2 The impulses transfer from the chip to a pedestal protruding from the scalp through connection wires.

3 The pedestal filters out unwanted signals or noise, then transfers the signal to an amplifier.

4 The signal is captured by an acquisition system and is sent through a fiber-optic cable to a computer. The computer then translates the signal into action, causing the cursor to move.

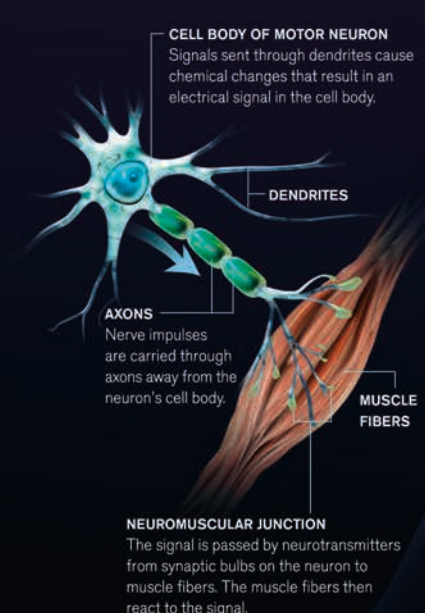
SILICONE CHIP

The chip is implanted in the brain's motor cortex.



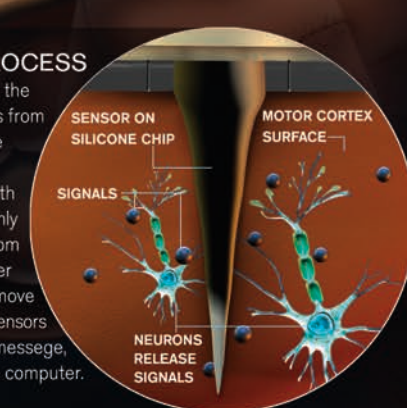
NORMAL NEURAL ACTIVITY

The BrainGate system relies on electrical signals from the brain the same as neurons in the nervous system. The difference lies in what happens after those signals are sent. In a healthy person, neuron activity that triggers movement occurs when motor neurons in the spinal cord start firing. Thousands, or even millions, of neurons in the motor cortex send signals to the motor neurons in the spinal cord, which, in turn, activate the muscle fibers that result in action. This process is impaired in people with damaged motor neurons or spinal cord injuries—the signals to trigger movement cannot be sent effectively from neurons through the spinal cord to muscles.

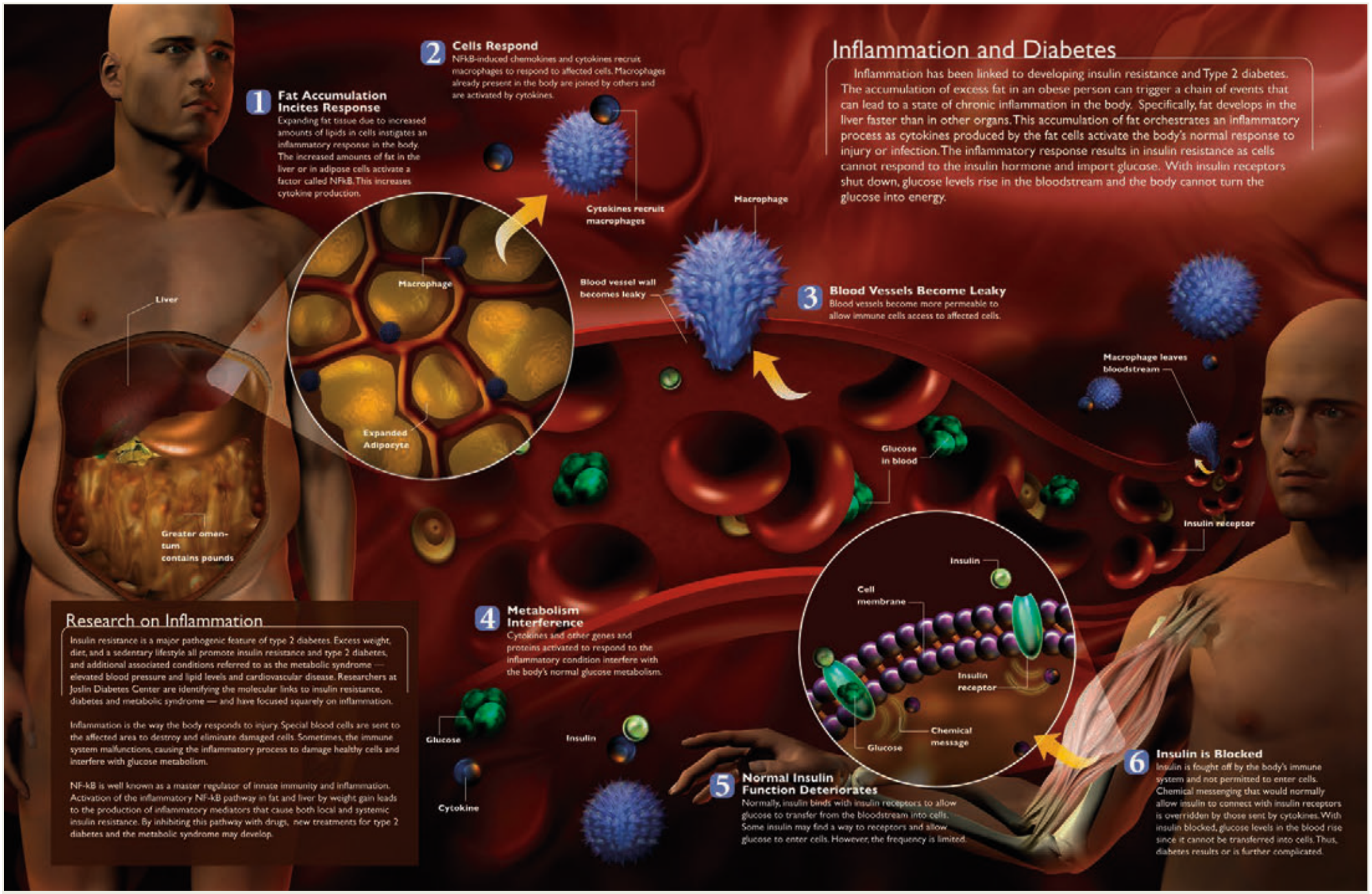


CHIP SENSOR PROCESS

Sensors, or electrodes, on the silicone chip detect signals from surounding neurons in the brain's motor cortex. This area is highly saturated with neurons, but each sensor only needs to detect signals from 10 to 50 neurons to trigger the BrainGate system to move the computer cursor. The sensors act as facilitators for the messege, which is carried out by the computer.



client: University of Chicago Hospital, *Medicine on the Midway* magazine *topic:* How the braingate system works



client: Joslin Diabetes Center at Harvard | *topic:* How inflamation impacts diabetes

Anatomy *of a* DISCOVERY
THE ROAD TO VELCADE

written by ELIZABETH DOUGHERTY
graphic by CHRISTINA ULLMAN

The story of Velcade ended happily, if not where anyone expected, when the collaborative effort to reverse muscle wasting led to the unexpected discovery of a lifesaving drug for multiple myeloma.

IMPOSSIBLE
MEDICINE

The Road to Discovery

The story of Velcade begins and ends with science. In between, a collaborative effort to develop a drug to reverse muscle wasting led to the unexpected discovery of Velcade, a treatment for multiple myeloma.

1972 Goldberg starts his lab

Lysosome theory fails

Attitude Affects Collaboration

New direction
An outside lab using the inhibitor discovers the proteasome's role in cancer and inflammation.

Proof

Proscript

A BIOTECH STATE OF MIND
The new recombinant DNA industry asks Goldberg for advice about protein degradation, turning the basic scientist into an unlikely player in biotechnology.

Biochemistry

DIY Center of Excellence
Goldberg founds MyoGenics to collaborate with scientists in other fields to inhibit the proteasome and slow muscle wasting.

Financial Support

EXPERIMENT TO INSIGHT
Insights from parallel biochemistry and physiology experiments lead Goldberg to speculate that slowing the proteasome might slow down muscle wasting seen in many diseases.

Clinical Results

Clinical trials
Anderson connects the inhibitor, now owned by Millennium Pharmaceuticals, to the Multiple Myeloma Foundation and other patient groups to recruit patients for Phase II trials.

HIDDEN AGENDA
Though officially focused on ending muscle wasting, Goldberg offers the MyoGenics proteasome inhibitor to scientists for free to encourage new discoveries.

Intellectual Property

Application

Next Generation Drugs
Many neurodegenerative diseases involve the accumulation of toxic proteins in cells, so Goldberg and others want to coax the proteasome to work faster.

New Uses

2003 FDA approves Velcade

Velcade
In the clinic, Velcade has helped extend the lives of more than 50,000 myeloma patients. In the lab, the inhibitor has influenced nearly all areas of biology, with more than 3,000 scientific references.

The Proteasome HOW IT WORKS

ubiquitin
ATP
protein
ubiquitin chain
proteasome
enzymatic sites
protein bits
ubiquitin
ATP
ADP
protein bits

1. By attaching tiny ubiquitin enzymes to a protein, a cell marks that protein for immediate disposal.
2. The barrel-shaped proteasome latches onto tagged proteins, unravels them, and pulls them inside.
3. Inside the hollow center is a molecular shredder lined with enzymes that slash the protein to bits.
4. The protein bits flow back into the cell where other enzymes degrade them further.

unravelling protein
proteasome
The bortezomib molecule binds inside the proteasome.
Bortezomib interrupts process.
An inhibited nuclear factor-kB enters the cell nucleus and helps to reduce inflammatory molecules, and the growth of myeloma cells.
NF-kB
cell nucleus
degraded protein pieces

Proteasome Inhibitor
JAMMING UP THE WORKS

The inhibitor slows the proteasome without stopping the essential process of protein degradation because it binds to just one of six active enzymes inside the proteasome, interrupting its work but allowing others to continue.

Champions of Invention

Alfred Goldberg
HMS Professor of Cell Biology
The "grandfather" of Velcade put the biochemistry of the proteasome together with physiology and was the first to imagine the therapeutic value of an inhibitor.

Julian Adams
Chief Scientific Officer and Senior Vice President of Research and Development, Infinity Pharmaceuticals Inc.
This pharmaceutical veteran made the first inhibitor, morphed it into a potent and safe drug, and amassed scientific data to quell toxicity concerns among potential partners.

Kenneth Anderson
HMS Kraft Family Professor of Medicine, HMS and Dana-Farber Cancer Institute
After a Phase I trial stumbled upon a disease target, Anderson joined Adams and convinced Millennium Pharmaceuticals to invest in Phase II trials for myeloma patients.

Paul Richardson
HMS Associate Professor of Medicine, Dana-Farber Cancer Institute
Richardson investigates novel drug combinations, mixing Velcade with other up-and-coming drugs. Results from trials of a triple-drug combination in 2010 are encouraging.

Milestones of discovery

1972 **Research Begins >** While other scientists are making proteins, Alfred Goldberg quits medical school to investigate how cells degrade them.

1977 **Discovering the Proteasome >** Goldberg discovers a novel pathway that disposes of old, broken, and misfolded proteins.

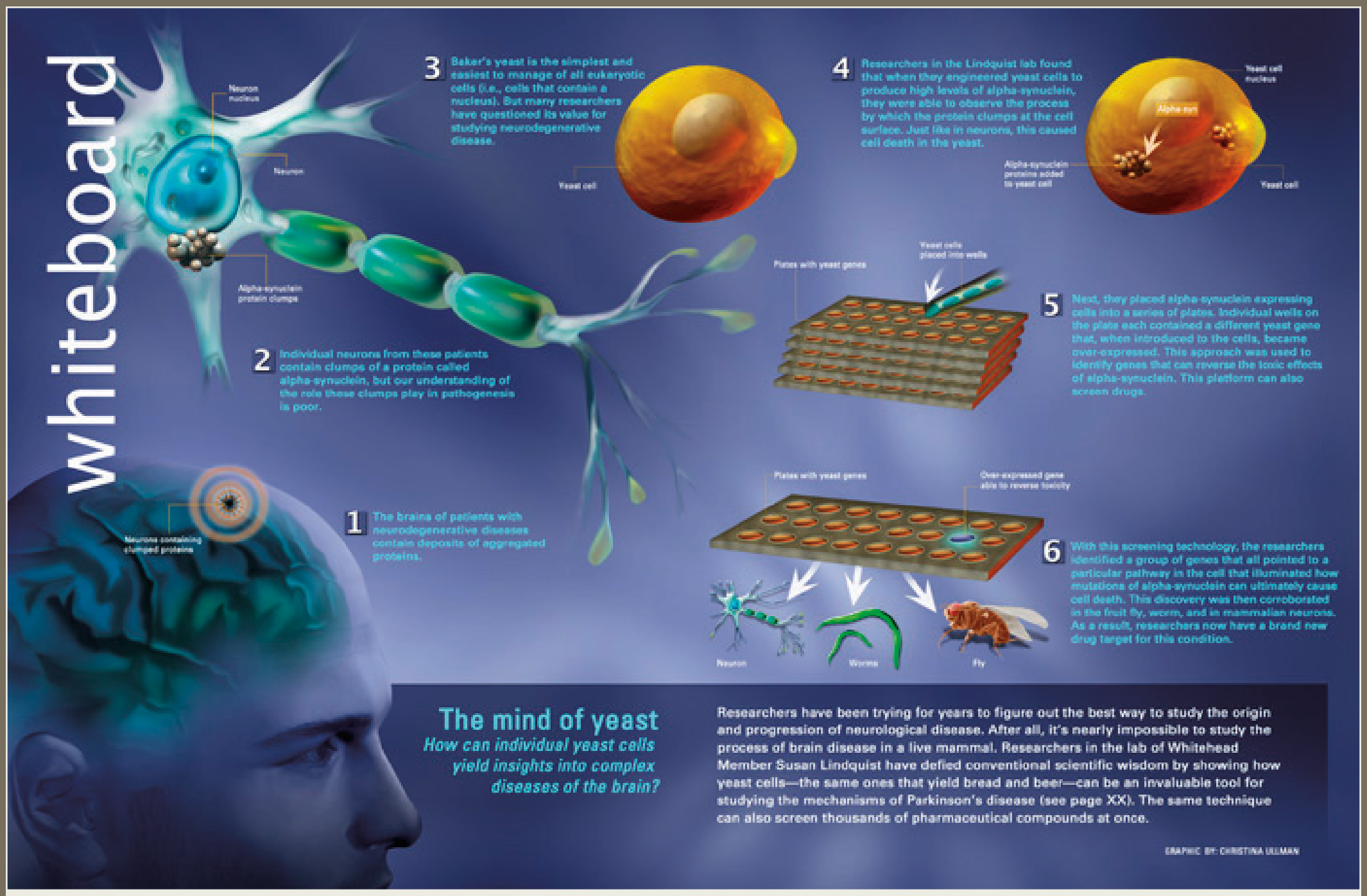
1987 **Understanding the Proteasome >** Evidence builds that the proteasome is an important regulator of many biological functions.

1994 **Discovering a Proteasome Inhibitor >** Julian Adams synthesizes the first proteasome inhibitor, an early formulation still widely used in scientific research.

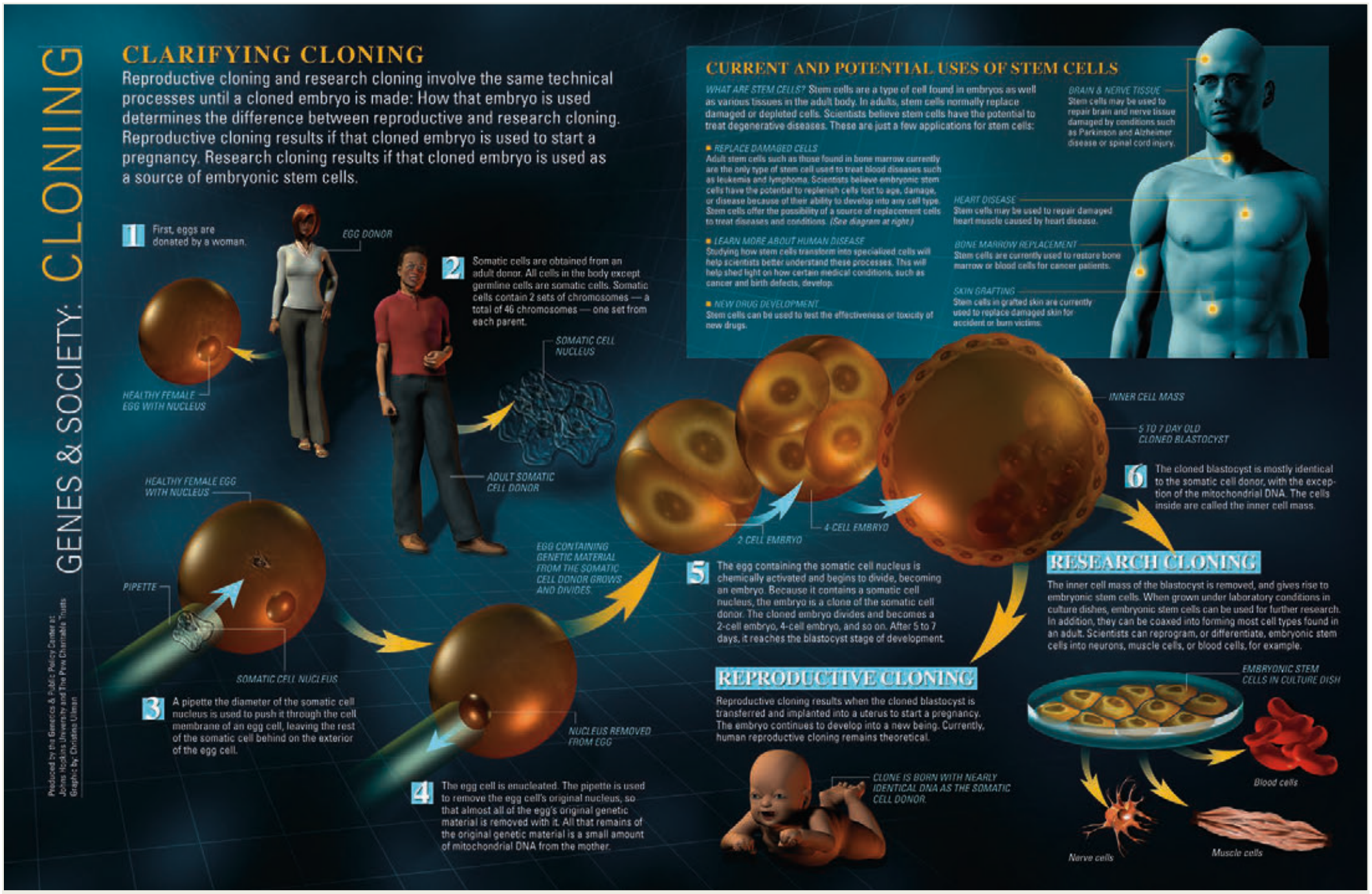
2000 **Discovering a Disease Target >** In Phase I trials of the inhibitor, one patient with multiple myeloma shows rapid and complete remission.

2003 **Approval >** The Food and Drug Administration approves the proteasome inhibitor bortezomib, or Velcade, to treat multiple myeloma.

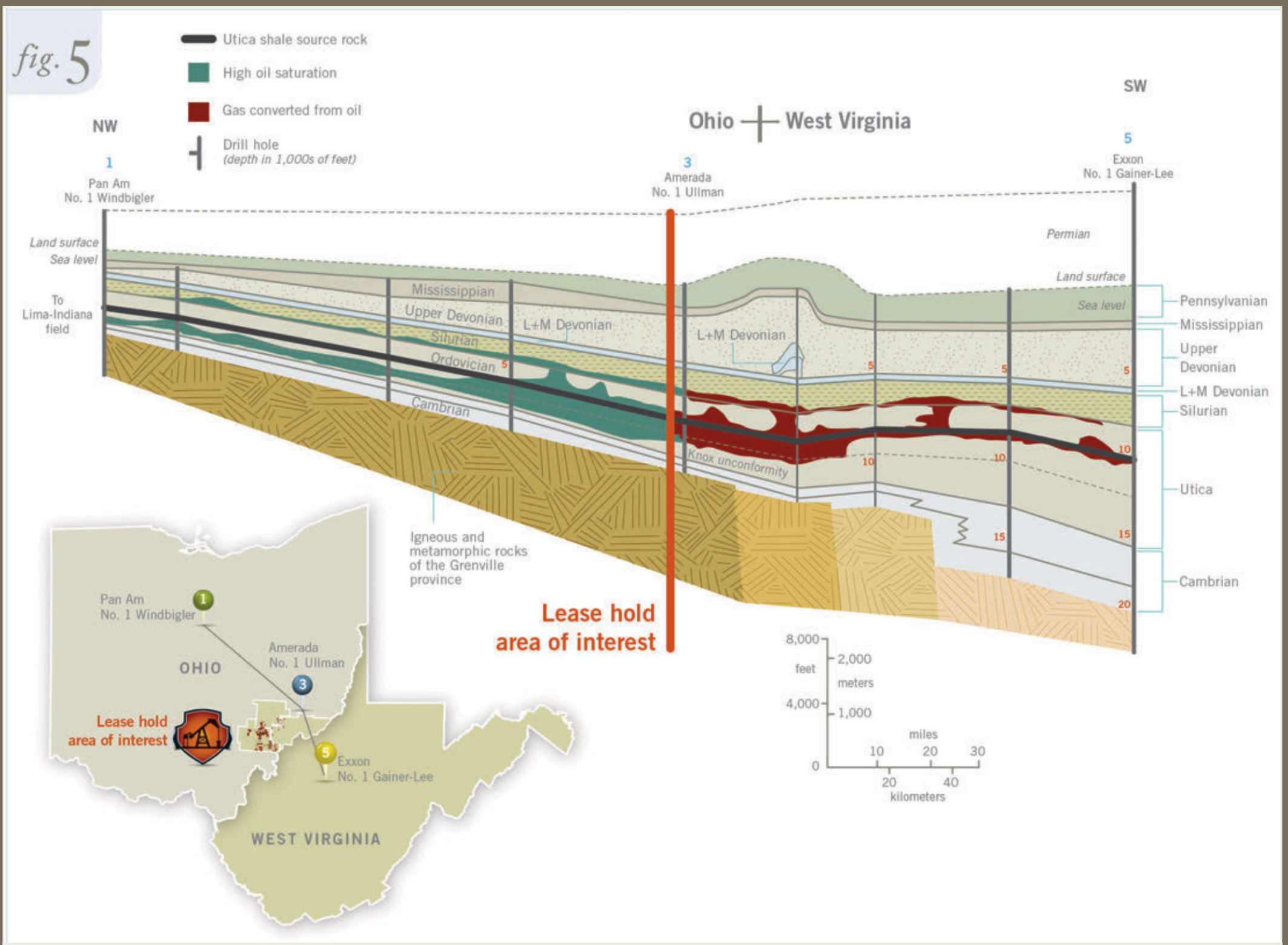
client: Harvard University, *Harvard Medicine* magazine | topic: The development of Velcade



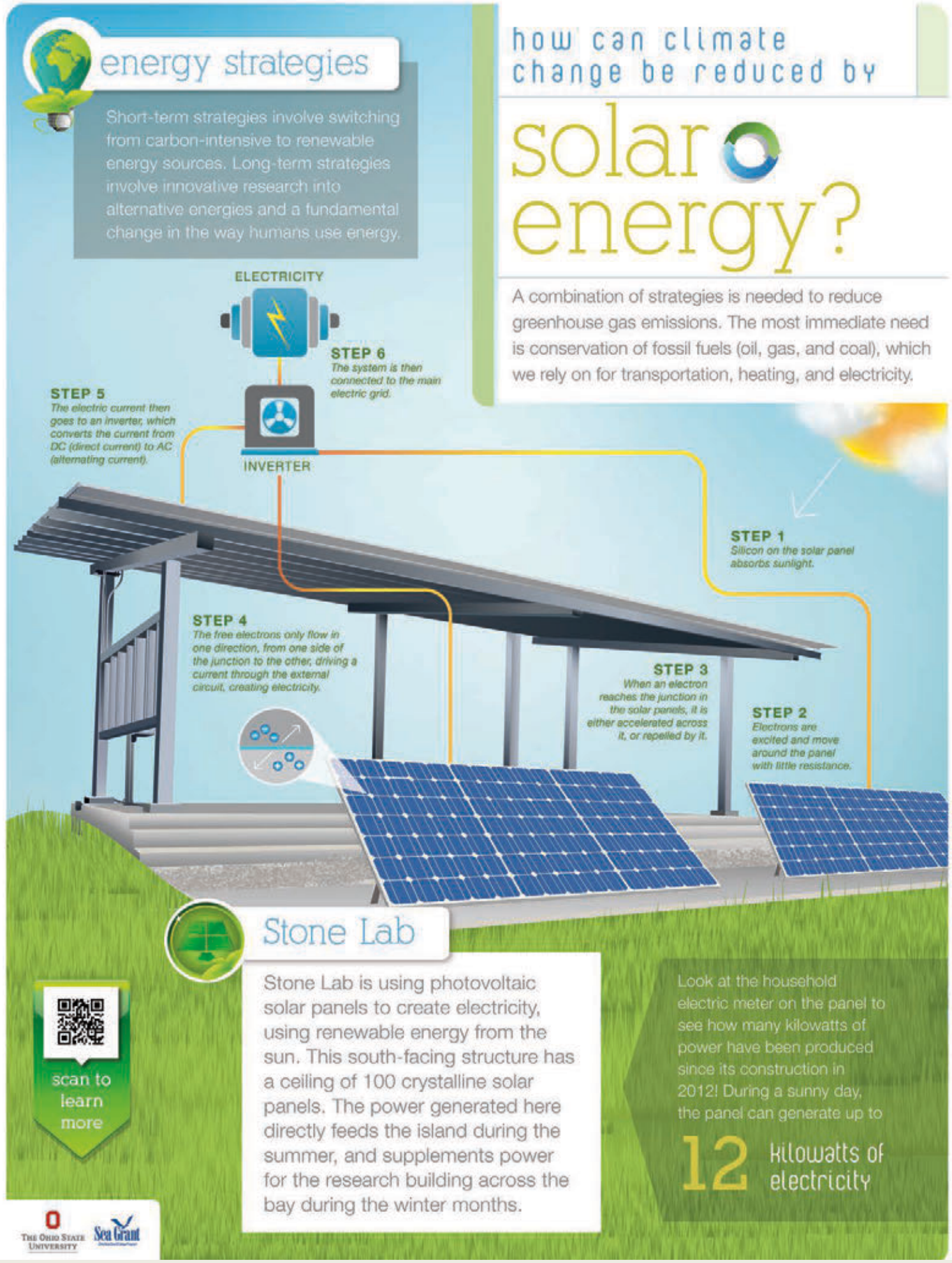
client: Whitehead Institute at MIT, *Paradigm* magazine | *topic:* Neurological disease treatment



client: Genetics and Public Policy Center at Johns Hopkins University | *topic*: Cloning



client: Cunningham Energy | topic: Utica shale geographic location



client: Ohio State University Ohio Sea Grant & Stone Lab | *topic:* Climate change informational kiosk

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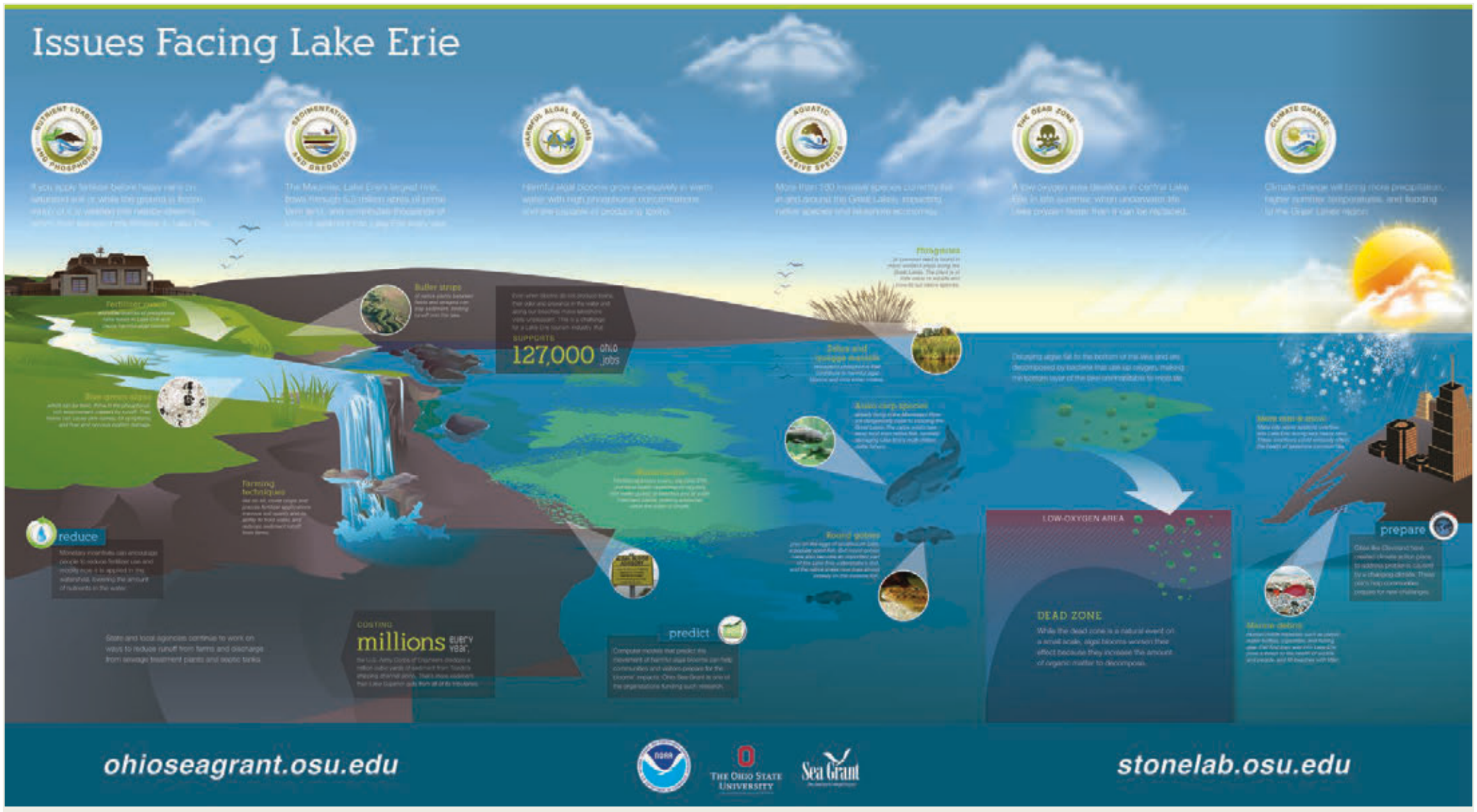
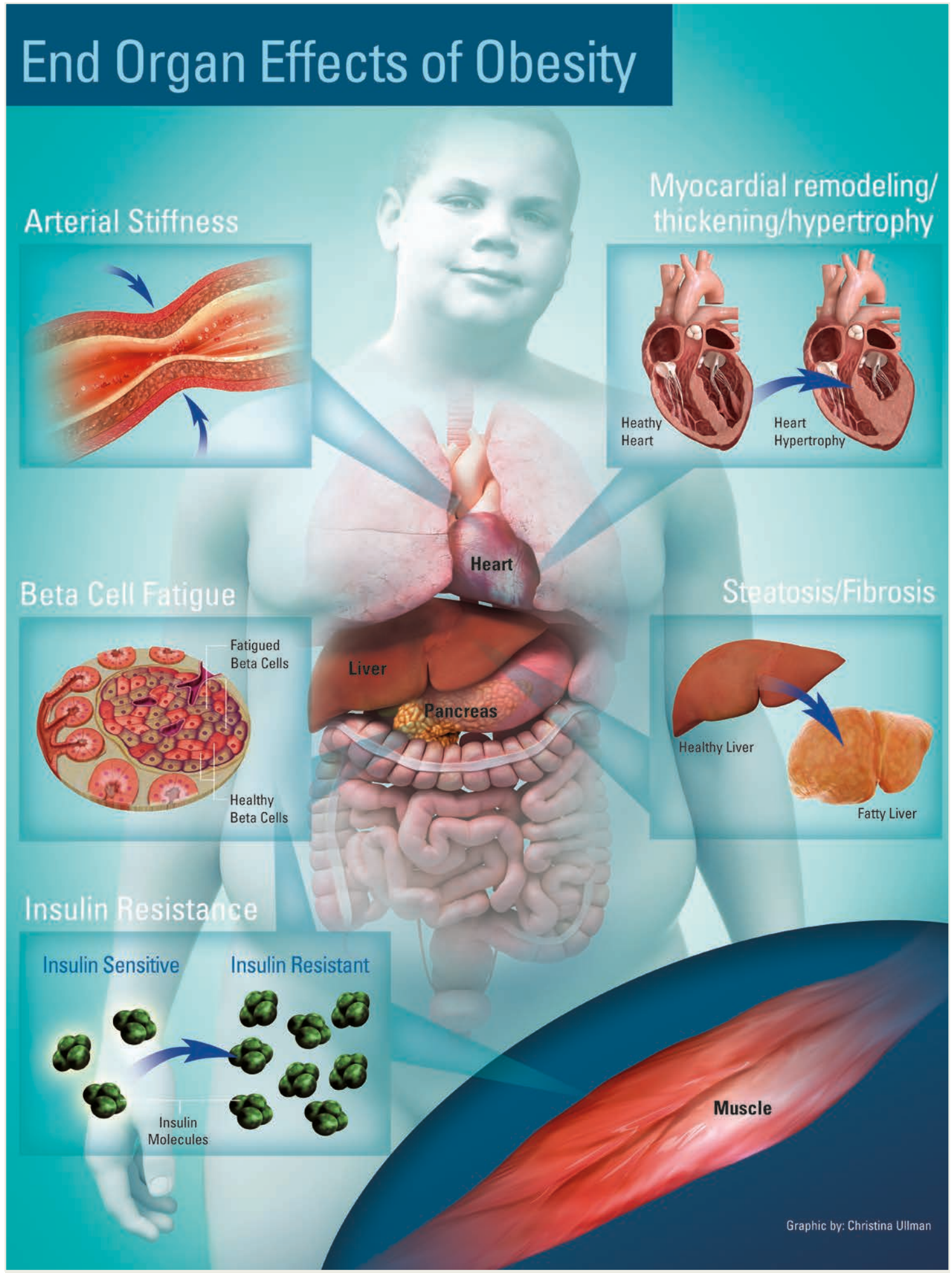
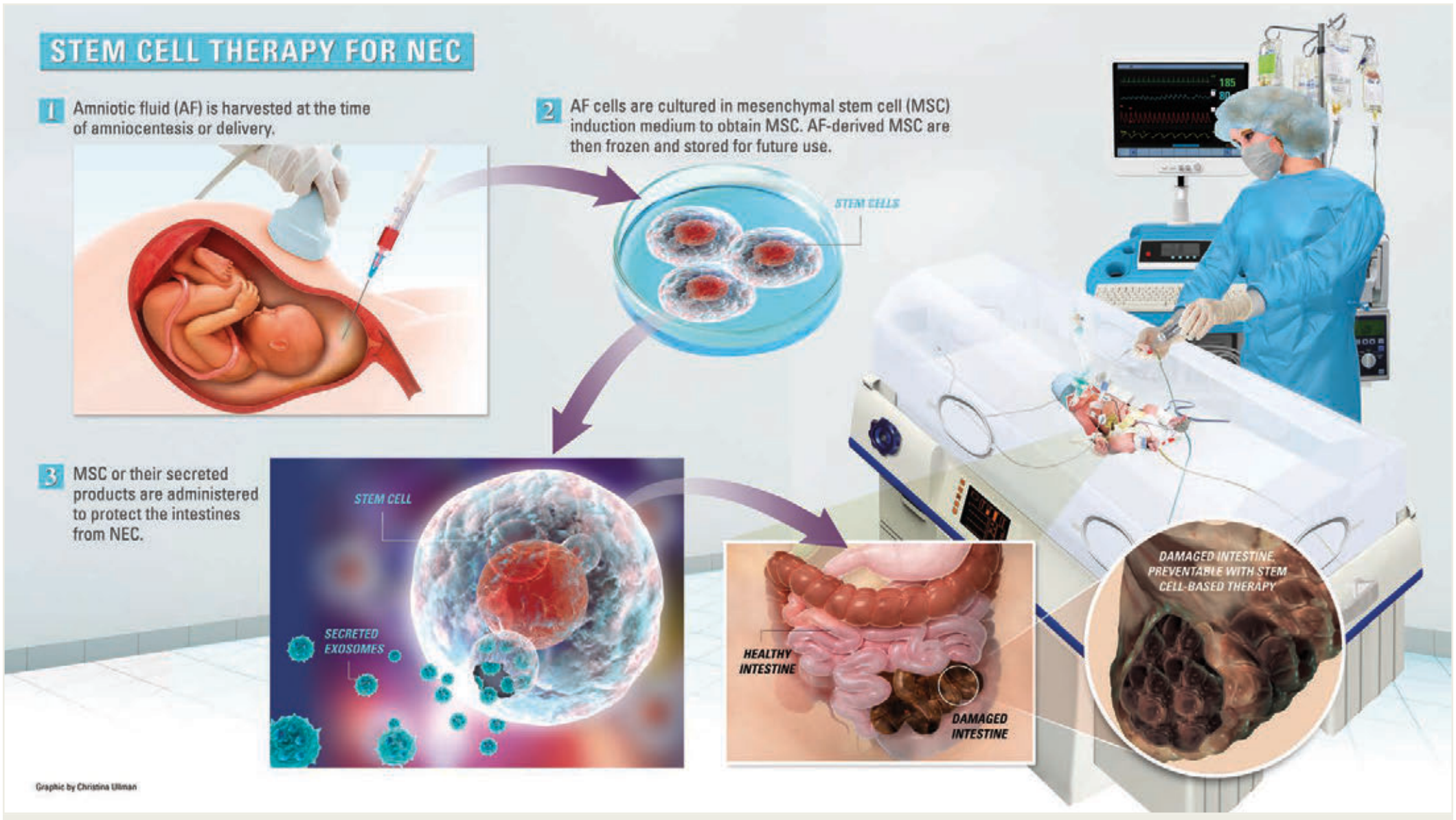


client: Ohio State University Ohio Sea Grant & Stone Lab | *topic:* Issues Facing Lake Erie graphic

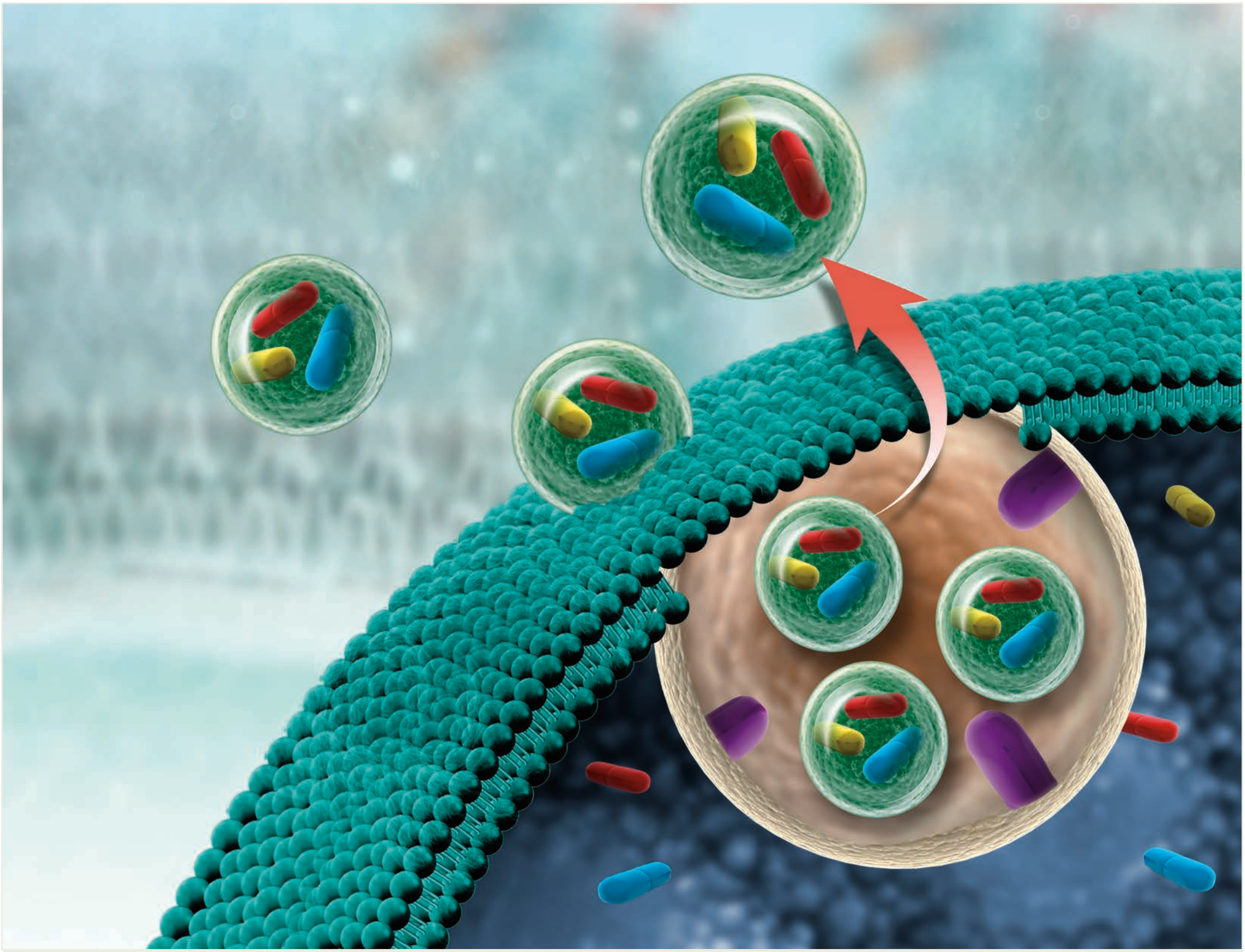
client: Ohio State University Ohio Sea Grant & Stone Lab | *topic:* Climate change informational kiosk



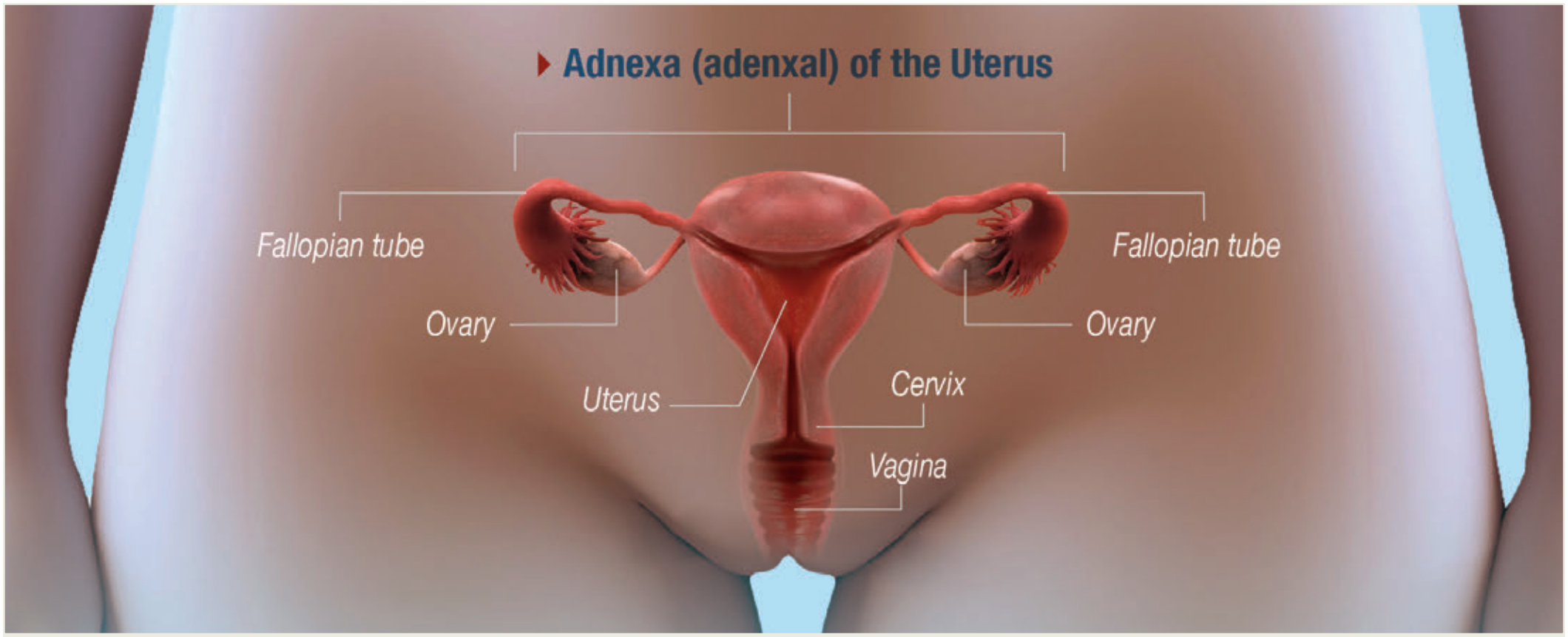
client: Nationwide Childrens Hospital | topic: End effects of obesity in pediatric patients



client: Nationwide Childrens Hospital | *topic:* Stem cell therapy for NEC

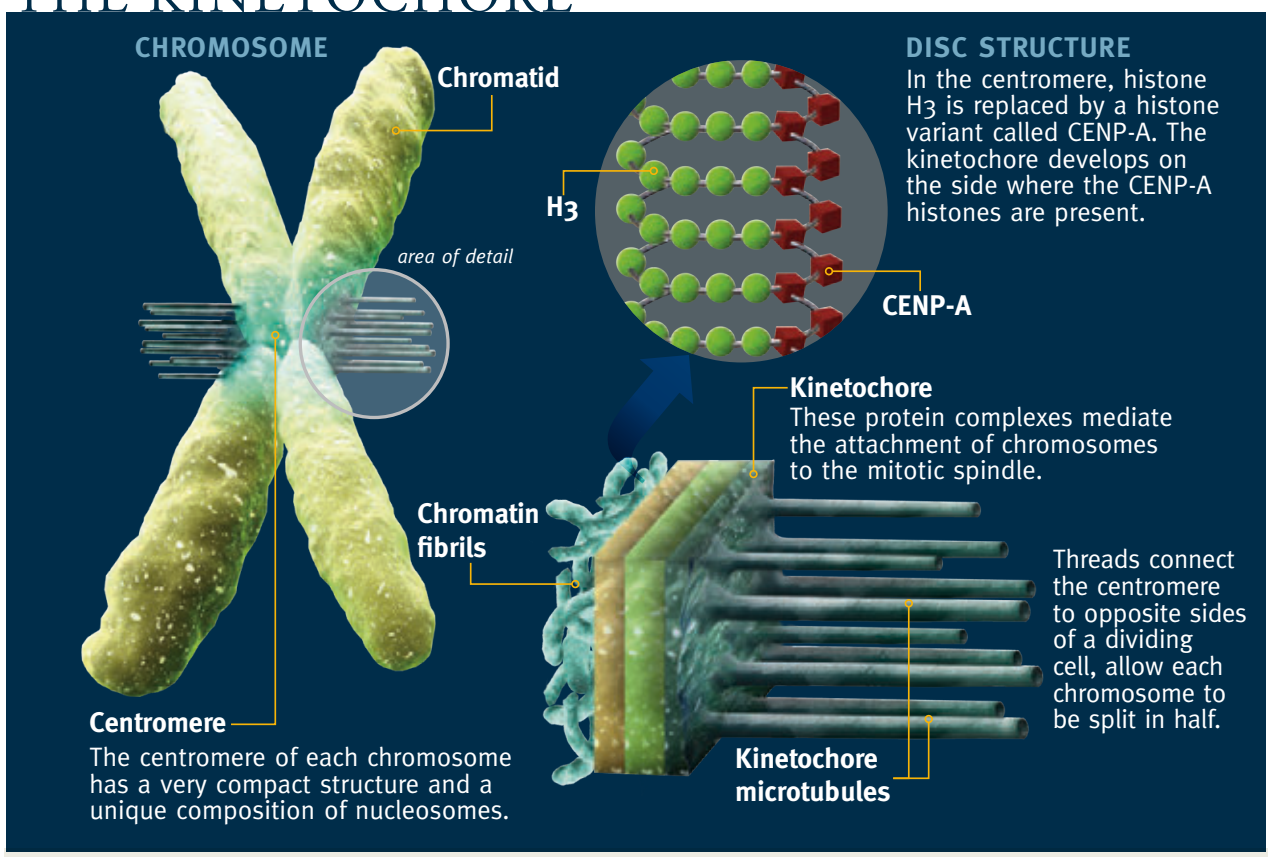


client: Nationwide Childrens Hospital | *topic:* Exosomes

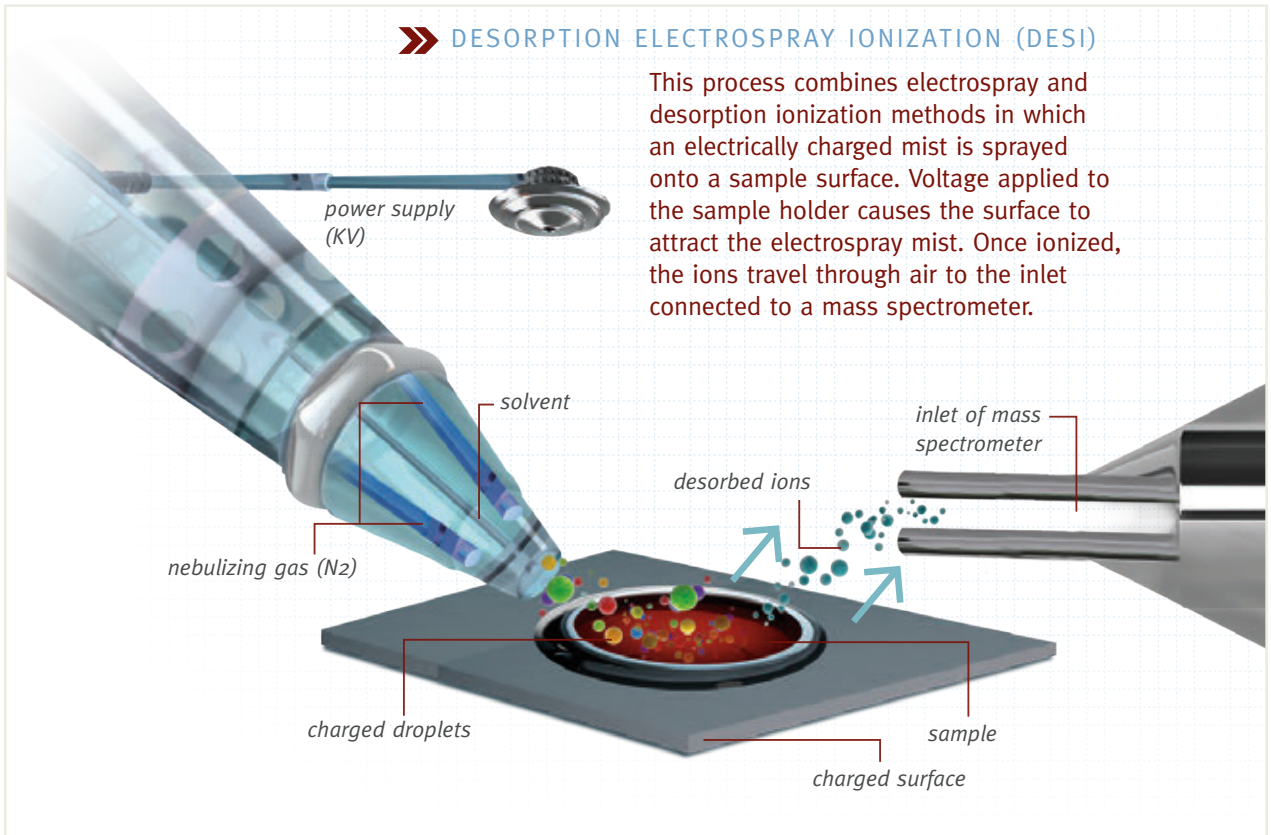


client: Nationwide Childrens Hospital | *topic:* Adnexa of the uterus

THE KINETOCHORE



client: Ludwig Institute for Cancer Research | *topic:* CENP-A



client: Ohio University, *Perspectives* magazine

topic: Desorption electrospray ionization (DESI) technology

Remote Control Treatment

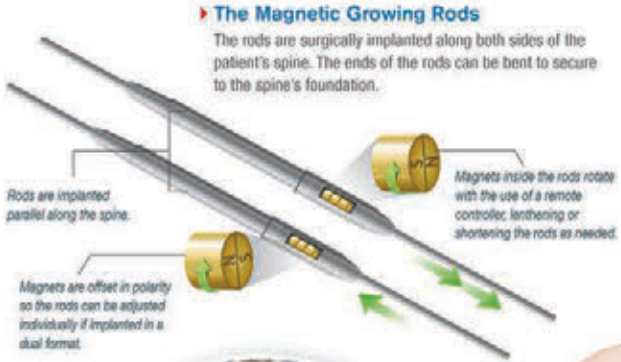
Magnetic growing rods help patients who have early-onset scoliosis avoid repeated surgeries

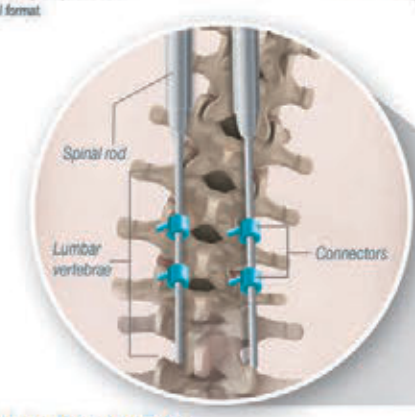
A common surgical treatment for young children with severe early-onset scoliosis is the implantation of growing rods or expandable titanium ribs. The devices are lengthened as the child grows, helping to straighten the spine. Lengthening involves surgery under general anesthesia every six months.

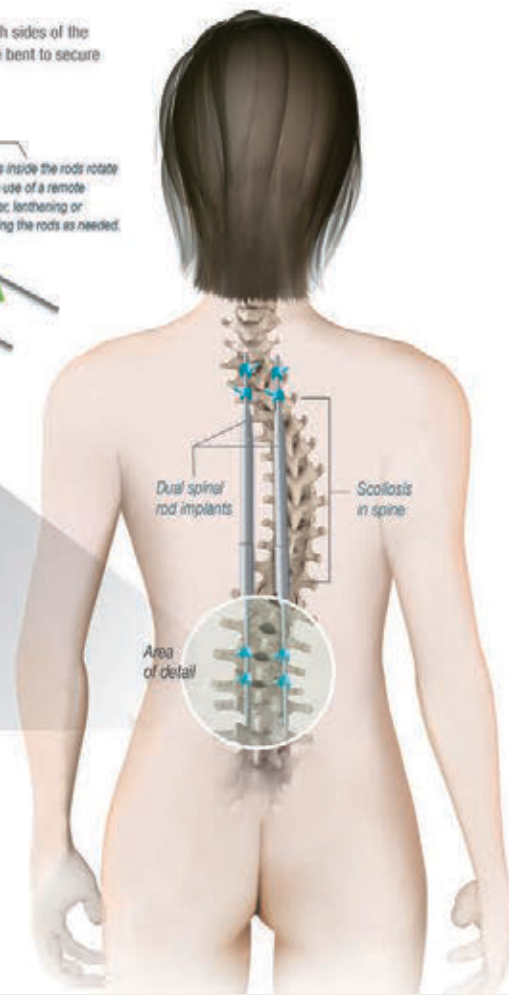
Magnetic Expansion Control (MAGEC) rods can be lengthened without an invasive procedure, however. They must still be implanted surgically, but they are lengthened magnetically with an external remote control. This takes place during short outpatient visits and causes little or no pain.

The Magnetic Growing Rods

The rods are surgically implanted along both sides of the patient's spine. The ends of the rods can be bent to secure to the spine's foundation.







Implanting the Rods

Rods are secured using fixation devices such as screws and hooks. The rods may be attached to the rib cage and spine, or to the spine only.

Sources: Walter P. Samora, MD, and Allan C. Beebe, MD, Department of Orthopaedics, Nationwide Children's Hospital; Ellipse Technologies, Inc.

Graphic by: Christina Ullman, Ullman Design

Lengthening the Rods

Patients undergo a short outpatient procedure approximately every two months to gradually lengthen the rods.

The magnets in the rods are located along the patient's spine.

The locations are noted on the patient's back for the external magnetic controller.

The external magnetic controller is placed over the patient's back. The controller locates the magnets through magnetic attraction, then is placed firmly over the area. The unit is controlled manually to lenthen the rods. Typically, rods are lengthened 3mm every two months.

Confirming the Adjustment

Lengthening the rod is confirmed through an X-ray of the patient's spine.

Nationwide Children's and Magnetic Growing Rods

The FDA approved the magnetic growing rod system in 2014. Nationwide Children's Hospital performed its first MAGEC procedure in June 2015, and has now completed ten implantations.

client: Nationwide Childrens Hospital | *topic:* Scoliosis treatment

Two Stage Surgery for Epilepsy

Surgery proves to be a viable option for patients with medically refractory epilepsy

Childhood onset epilepsy affects 1 percent of children worldwide. About 25 to 30 percent of these patients will have medically refractory epilepsy, continuing to have seizures despite using two or more antiseizure medications. Options for this group of patients include intercranial epilepsy surgery, Vagus nerve stimulator (VNS) insertion, Ketogenic diet and drug trials. It is increasingly recognized that epilepsy surgery may dramatically improve the quality of life for these children in some cases and is the only potentially curative option.

Phase I Monitoring

Phase 1 is an extensive presurgical workup that helps the neurologist localize the seizures and determine the patient's candidacy for epilepsy surgery. This involves multiple-day inpatient admission, prolonged video EEG and intended observation of at least three typical seizures.

The patient also undergoes imaging sequences including positron emission tomography (PET), single photon emission computed tomography (SPECT) and epilepsy protocol MRI, in addition to outpatient neuropsychology testing. Potential surgical candidates and all of their clinical and radiographic data are discussed thoroughly at the weekly Epilepsy Surgery Conference. Depending on the results from the Epilepsy Surgery Conference, single stage epilepsy surgery, two stage epilepsy surgery, or palliative surgical options (corpus callosotomy or VNS insertion) may be offered.

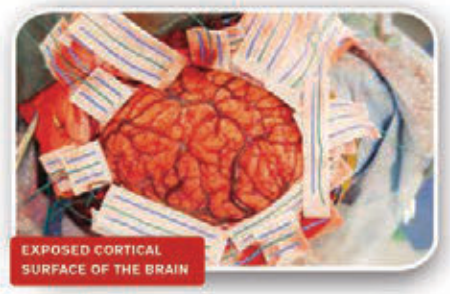
Single or Two Stage Epilepsy Surgery

Single stage surgery is performed if imaging and phase 1 data demonstrate concordant findings suggestions lesional epilepsy. It involves resection of the lesion and electrocorticography to ensure all abnormal tissue is removed. Alternatively, diffuse pathology affecting a cerebral hemisphere may warrant hemispherectomy/hemispherotomy.

Two stage surgery is performed when phase 1 monitoring contains discordant data or inadequately localizes the epileptogenic zone. This approach allows identification of the epileptogenic zone, potential adjacent areas of abnormal electrical activity and nearby eloquent functional areas of the brain. Eloquent areas of cortex are localized by cortical stimulation mapping.

Stage 1 Surgery

During stage 1 surgery, craniotomy and dural opening allow exposure of the cerebral cortex. Working in collaboration, the neurosurgery and neurology teams identify sites of coverage and access for subdural grids, strips and/or depth electrodes. Intraoperative electrocorticography confirms adequate placement and signals of intracranial EEG electrodes. The electrodes are safely secured in place as the dura is subsequently closed.


EXPOSED CORTICAL SURFACE OF THE BRAIN

Sources. Jonathan A. Pindrik, MD, pediatric neurosurgeon, Nationwide Children's
Satyanarayana Gadela, MD, pediatric neurologist, Nationwide Children's
Graphic by: Christina Ullman, Ullman Design

Phase 2 Monitoring

During phase 2 monitoring, continuous, long-term intracranial EEG is monitored for approximately one week to identify abnormal electrical signals before and during seizures. Frequently, antiepileptic medications are weaned to help capture typical seizure activity (at least three events).

Near the conclusion of phase 2 monitoring, corticostimulation mapping may identify eloquent functional areas that will help surgical planning. Additional discussion during the Epilepsy Surgical Conference solidifies the surgical plan.

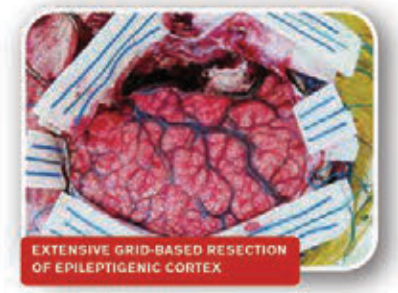
EEG technicians and epileptologists continuously monitor the prolonged video EEG in real time.

Stage 2 Surgery

Stage 2 surgery typically involves grid-based resection of the epileptogenic zone with careful preservation of adjacent eloquent functional areas. Intraoperative electrocorticography confirms the absence of any residual abnormal electrical activity or identifies additional sites requiring resection.

Post operative recovery Following surgery, patients are monitored closely in the pediatric intensive care unit. Once stable, they are transferred to the neurosurgery floor for further recovery. Often patients are discharged to home. However, if needed, transfer to Inpatient Rehabilitation allows for prolonged recovery.


SUBDURAL CONVEXITY GRID OVERLAYING CORTICAL SURFACE


EXTENSIVE GRID-BASED RESECTION OF EPILEPTIGENIC CORTEX

client: Nationwide Childrens Hospital | topic: Epilepsy surgery

client: Nationwide Childrens Hospital | topic: Types of pyloric atresia

GALATIC WONDERS

OUR GALAXY

The Milky Way is a spiral galaxy in a cluster of galaxies called the Local Group, which is composed of 36 galaxies. The Milky Way is relatively large, with a strong gravitational influence on smaller nearby galaxies. The name "Milky Way" was given by the Greeks, who thought the white band of light looked like flowing milk.

HALO
Consists of gases and ancient stars

GLOBULAR CLUSTERS

SPIRAL ARMS
The arms coiled around the center of our galaxy consist of dust, gas clouds and billions of stars.

LOCATION OF OUR SOLAR SYSTEM

THE BULGE
At then center of the galaxy are remnants of exploding stars and molecular clouds of gases. Recently, NASA scientists have discovered it may also contain a supermassive black hole.

A STAR IS BORN

New star formation takes place in a nebula — enormous clouds of cosmic dust and gases. While this process is simplified here, it takes millions of years for a star to form. The more massive the star, the faster the process.

PROFILE OF THE MILKY WAY

Halo
Bulge
Sun's location
Disk
Globular clusters
100,000 light years

Sagittarius A
(Possible location of a black hole)

BLACK HOLE?
Near the galatic center of the Milky Way is a bright area known as Sagittarius A — where the black hole is suspected to be. A black hole is created when a star collapses on itself in an explosion called a supernova. Black holes have an immense gravitational force, and swallow up large amounts of celestial matter.

Core heats up

Spinning dust and gases

Disk

Core

Gases fire out along its rotation axis

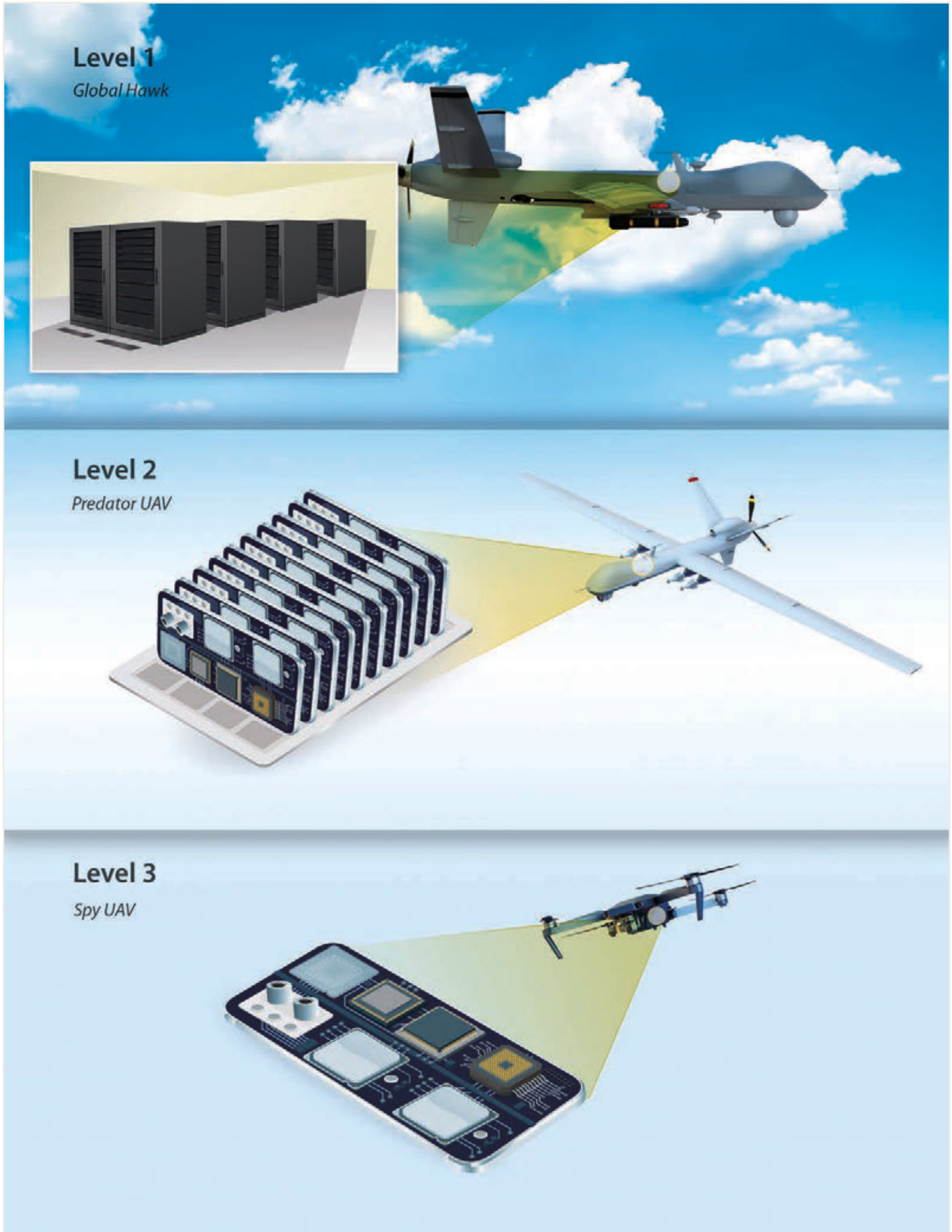
1 THE NEBULA
As gases and dust particles are drawn together by angular momentum, the nebula spins and the center becomes extremely hot.

2 THE YOUNG STAR
As the central core continues to heat up, the spinning motion causes it to flatten into a prototstellar disk as it collapses. Hydrogen is transformed into helium and the star begins to "shine."

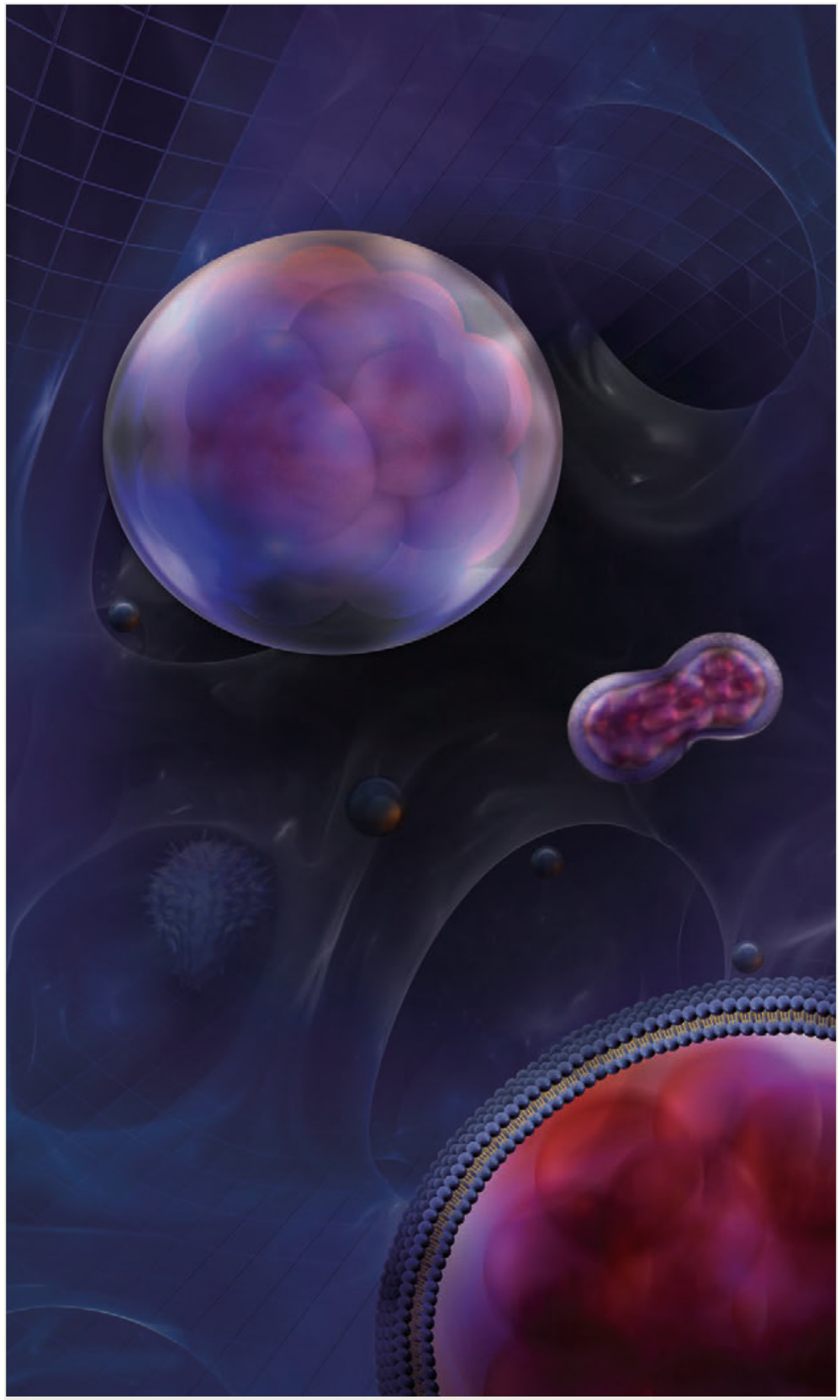
3 THE PROTOSTAR
During the later stages of collapse, the protostar develops a high protostellar wind which causes high-speed gases to fire outward from the center.

GRAPHIC: Christina Ullman
SOURCES: NASA, *The Cosmic Perspective*, and *Scholastic Atlas of Space*

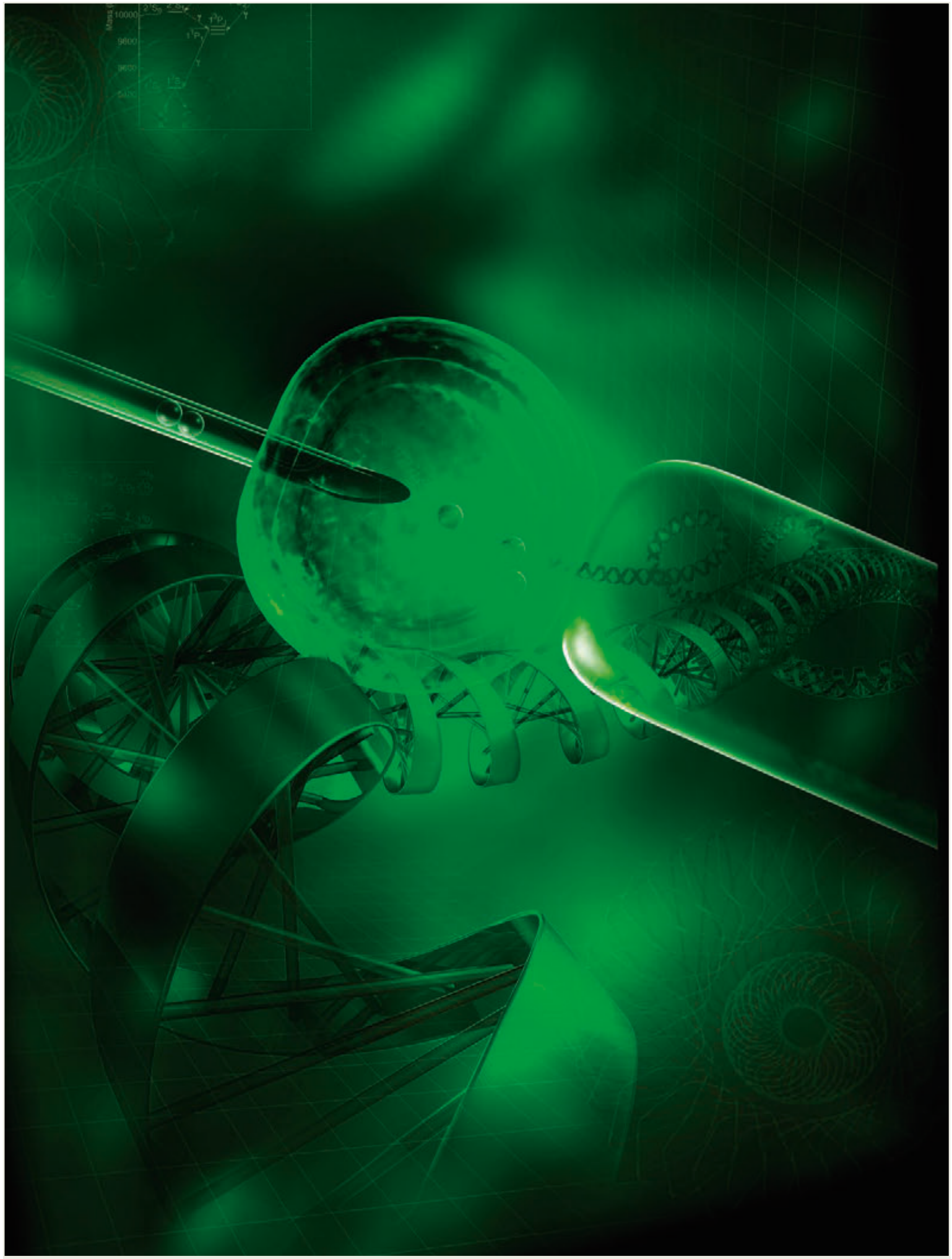
client: Ohio University Office of Research Communications, *Perspectives* magazine | topic: Milky Way galaxy



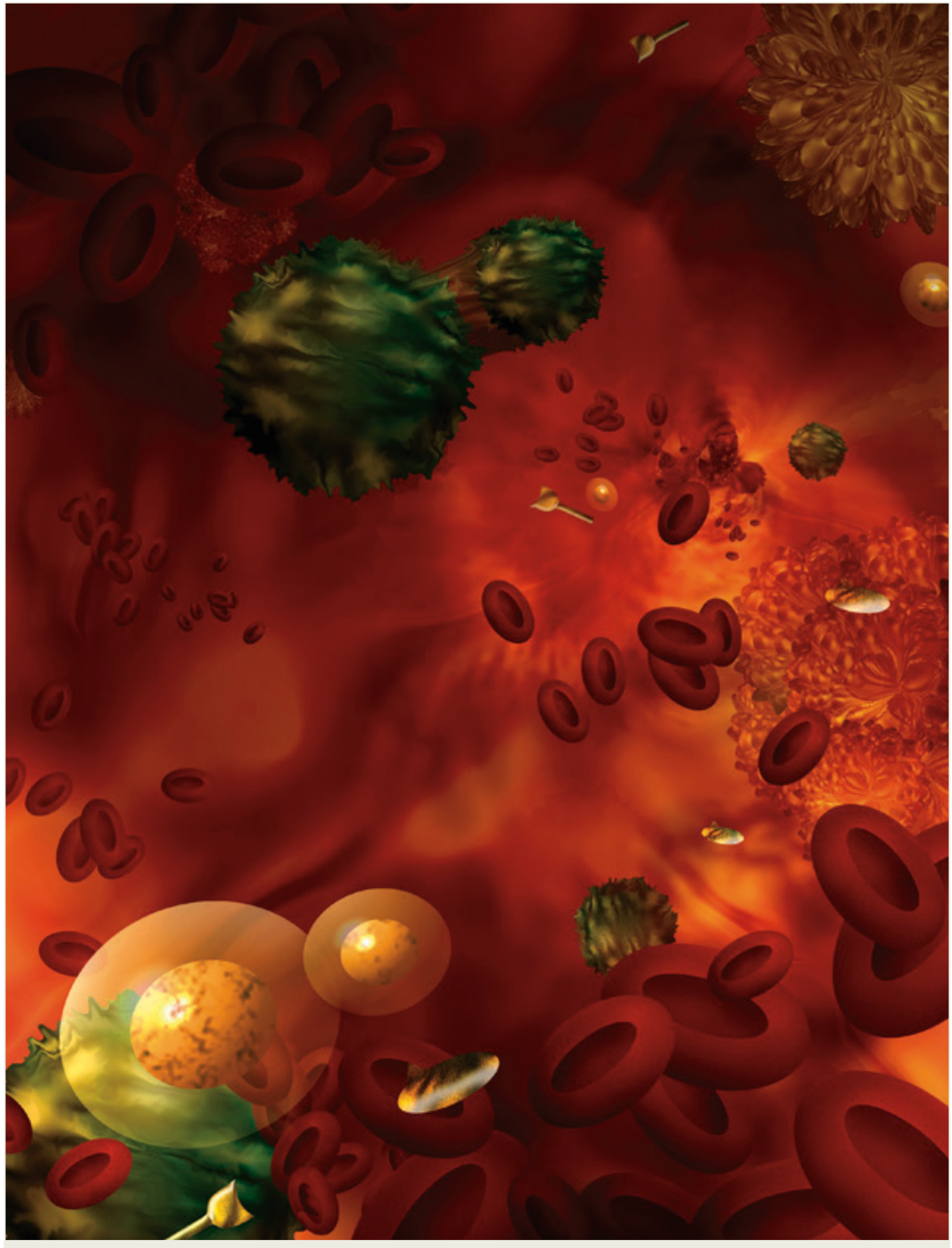
client: Purdue University, College of Engineering | *topic:* Drone computational hierarchy



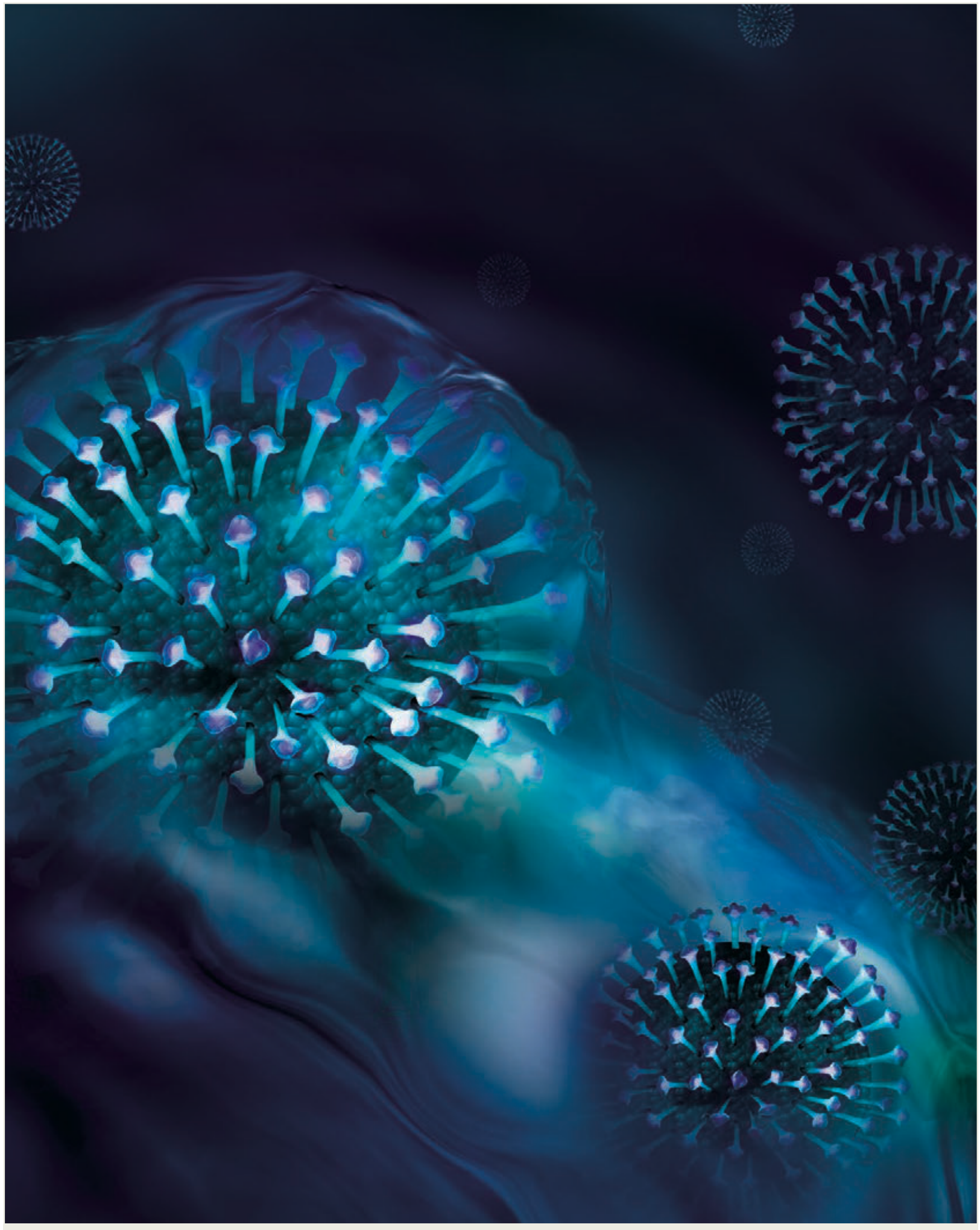
client: Johns Hopkins University Institute for Cell Engineering | *topic*: Stem cells



client: Johns Hopkins University Institute for Cell Engineering | *topic:* Stem cells and DNA



client: Whitehead Institute at MIT, *Paradigm* magazine | *topic:* Cancer treatment



client: University of Georgia, *Research* magazine | *topic:* HIV integrase