Neuroscience Across the Continuum

The Neuroscience and Persons (NAPs) Program, NIH-funded Research, Service Learning, Educational and Community Outreach

For more information:
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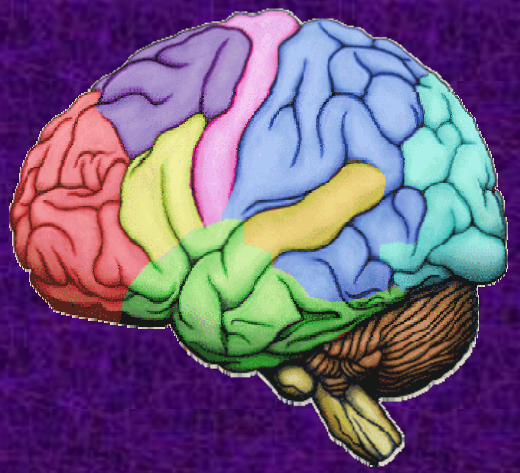
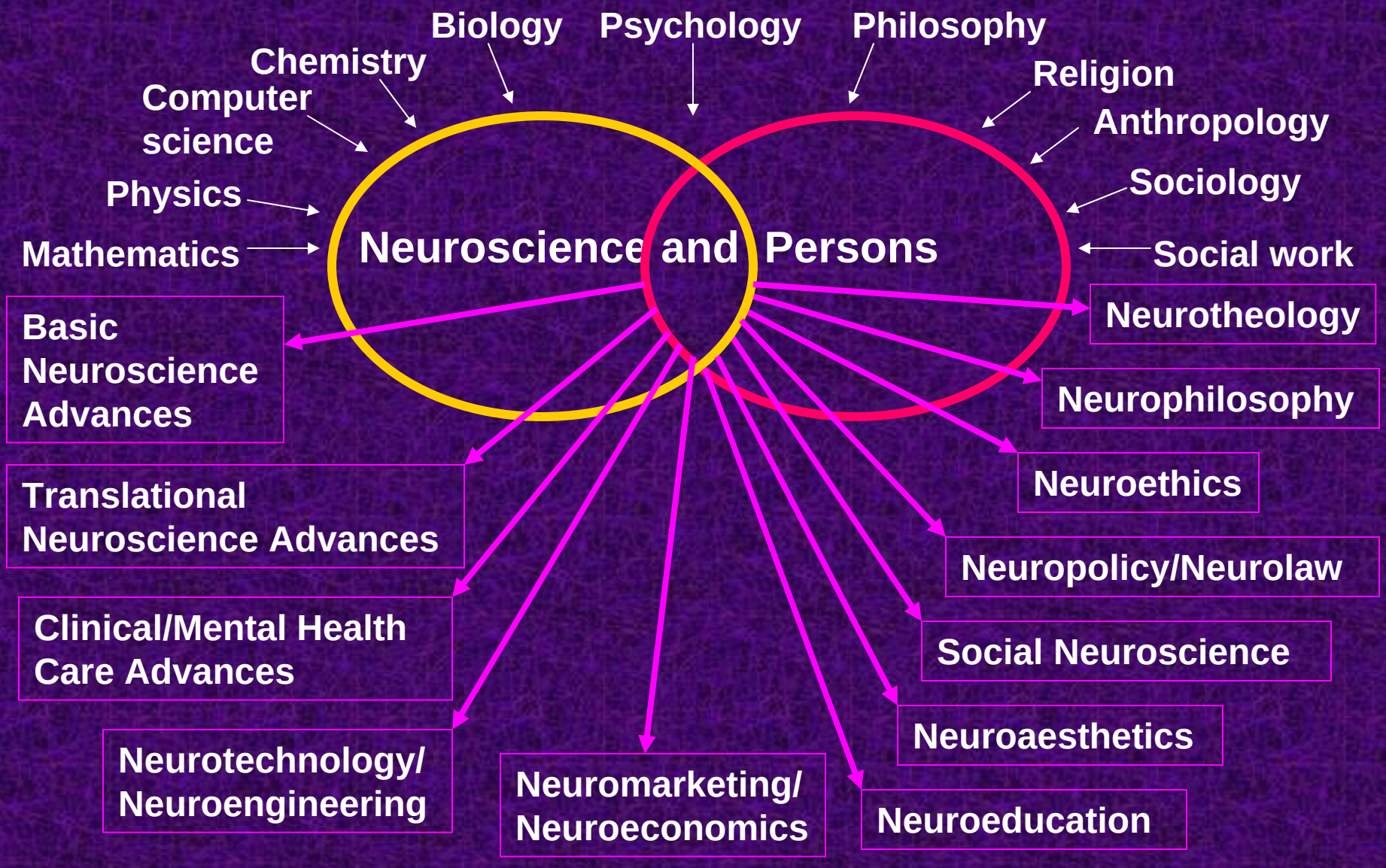


Welcome to the Century of the Brain!

- Neuroscience as it relates to our personhood is one of the most important fields of the 21st century.
- The Neuroscience and Persons (NAPs) program is intended to prepare Christian students & others to understand, assess & effectively contribute to the dramatic changes that will occur as we come to better understand how the nervous system affects our personhood & ultimately our society & world.

Welcome to the Century of the Brain!



The NAPs Program: Crossing the continuum of education & community with neuroscience awareness

- Encourages & trains NWC students in neuroscience through the 2-track NAPs program for undergraduates & NIH-funded research: prepares the next generation of neuroscience/science educators & researchers
- Encourages outstanding young high school biology students to consider neuroscience-related careers through the Northwestern Neuroscience Camp (NNC) each summer that draws interested students from across the country
- Reaches out with annual Brain Awareness Week (BAW) events in elementary & high schools & other venues (e.g., public libraries, home school events, neuroscience lab visits by pre-med/pre-vet college clubs, other groups, campus-wide Days of Learning in community)
  - Goal: make people of all ages more aware of neuroscience & its increasingly important role in society

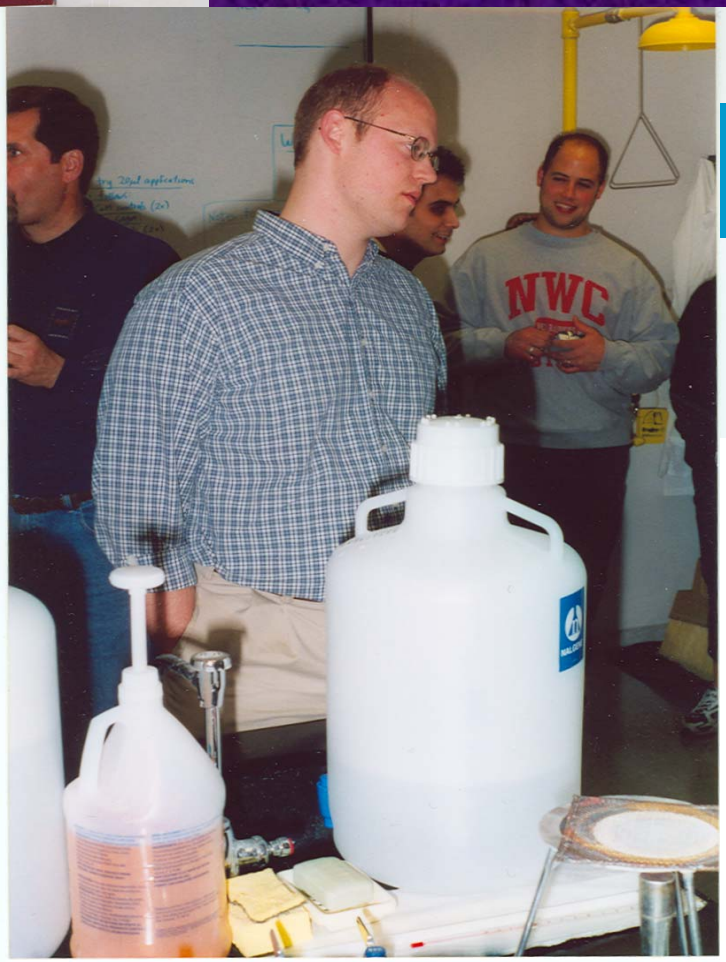
Training the researchers & health professionals of the future with National Institutes of Health (NIH) funded research

Some of the 20+ Honors Research, Junior Scholar or Directed Study students who have been trained in research supported by National Institutes of Health Research (NIH) grants over the last few years. Most have gone on to further professional training in the health professions as medical doctors or doctors of osteopathy or to graduate schools to earn doctorates in areas like physiology and biochemistry.

Research students have opportunities to present their research results as thesis papers & at seminars open to the college community or off campus at regional neuroscience meetings.

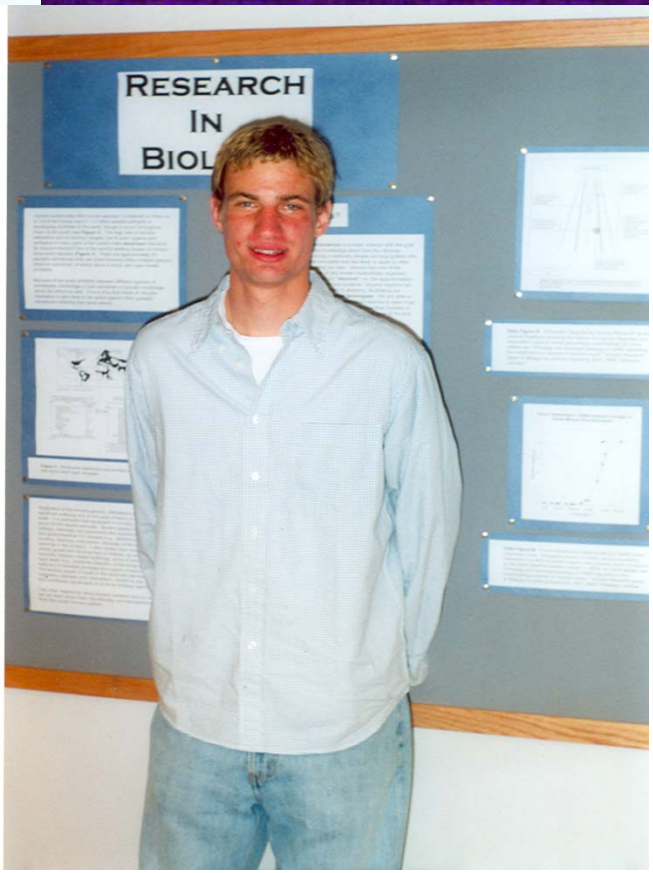
Jason completed a prestigious Sarnoff Cardiovascular fellowship for physician-scientists interested in cardiovascular research as part of his medical training.

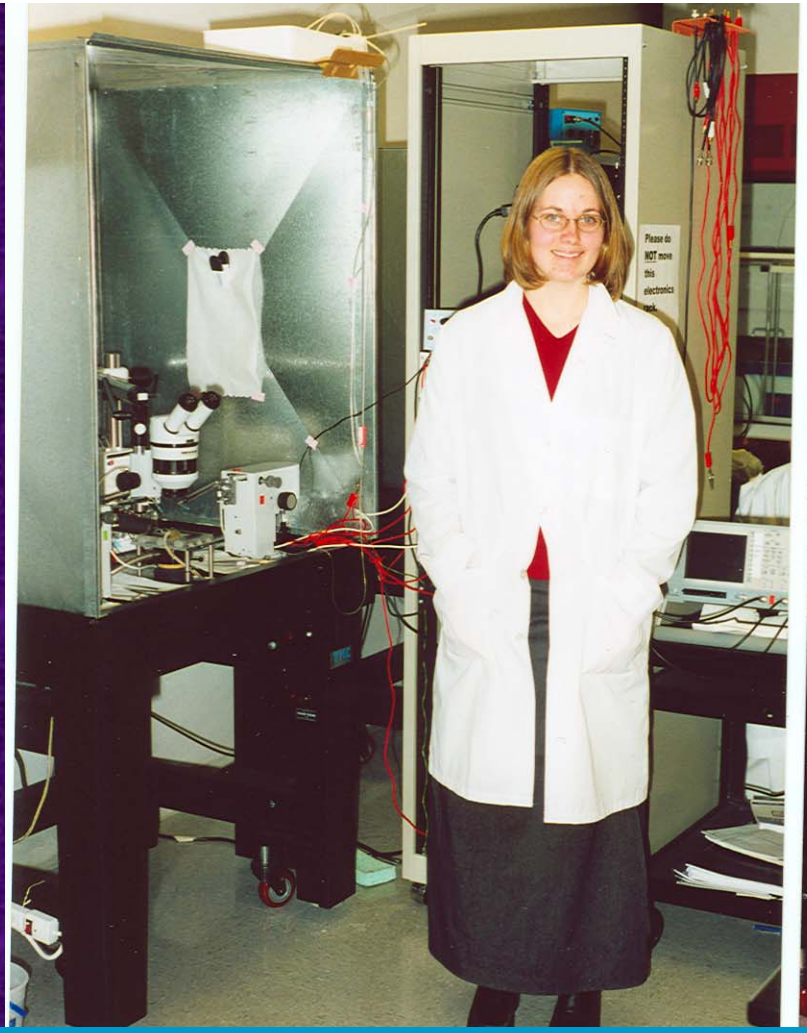
JoAnna has now completed her Doctor of Osteopathy training.

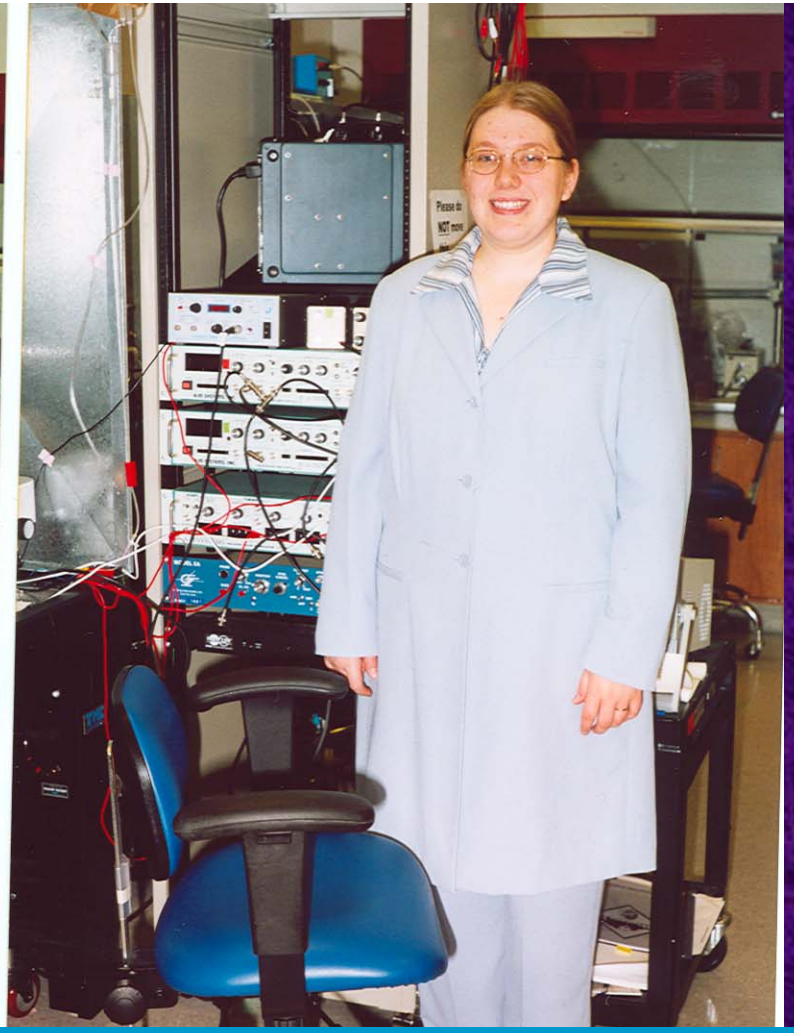


Josh has gone on to specialize in otolaryngology.

Matt has gone on to specialize in surgery.



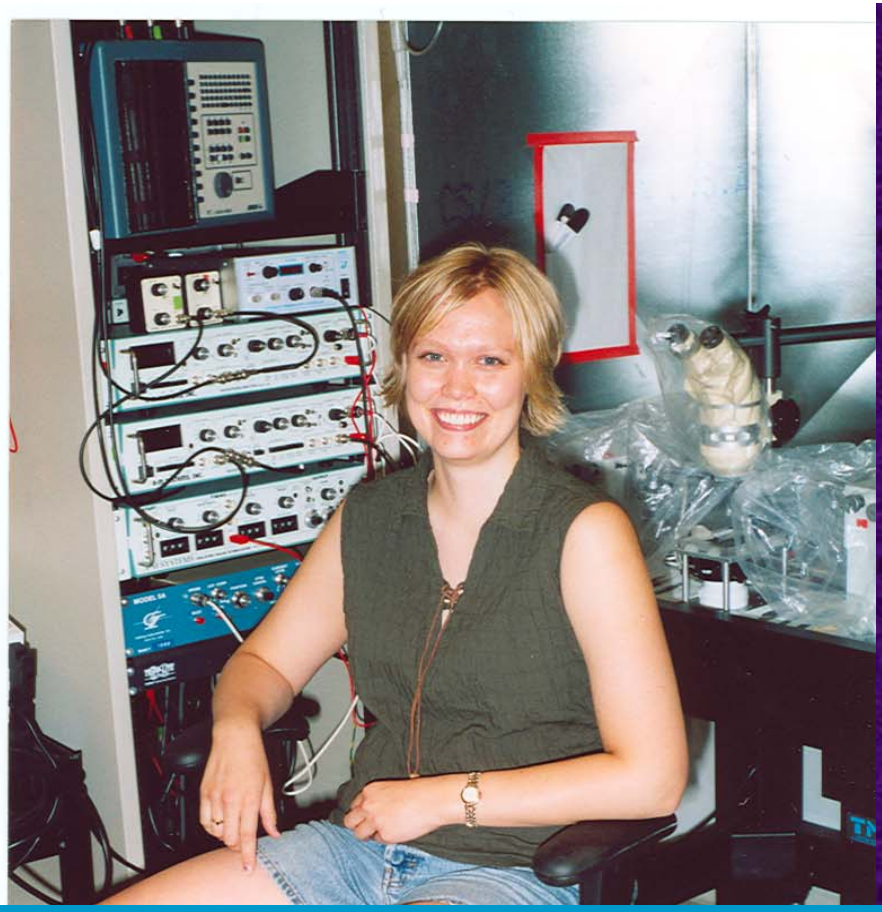




Sarah Wynia has completed her Ph.D. in physiology at UW-Madison studying the biophysics of mutant Herg channels in the heart that cause cardiovascular disease-related arrhythmias. She has also served as the President of the InterVarsity Graduate Student Fellowship at UW-Madison. Malinda Burke has completed her Master's in Science Education at University of Nebraska –Lincoln and is a science teacher in Lincoln.

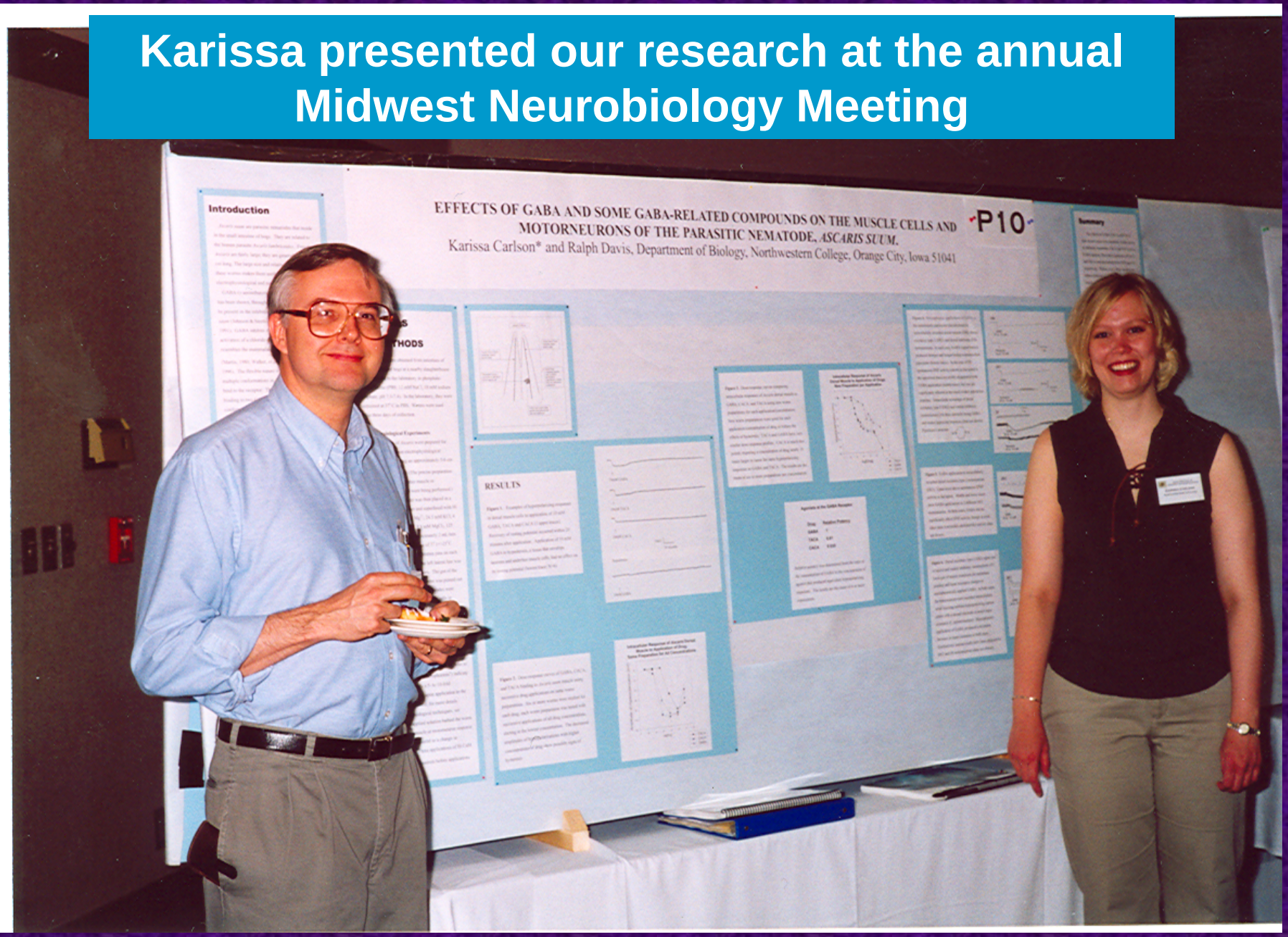
More former research students who have received research training through NIH-funded research grants…

Peter Boerema currently does laboratory research at the pharmaceutical company, Hematech, focusing on the incorporation of the human immune system into cattle for harvesting much needed human polyclonal antibodies to fight disease.

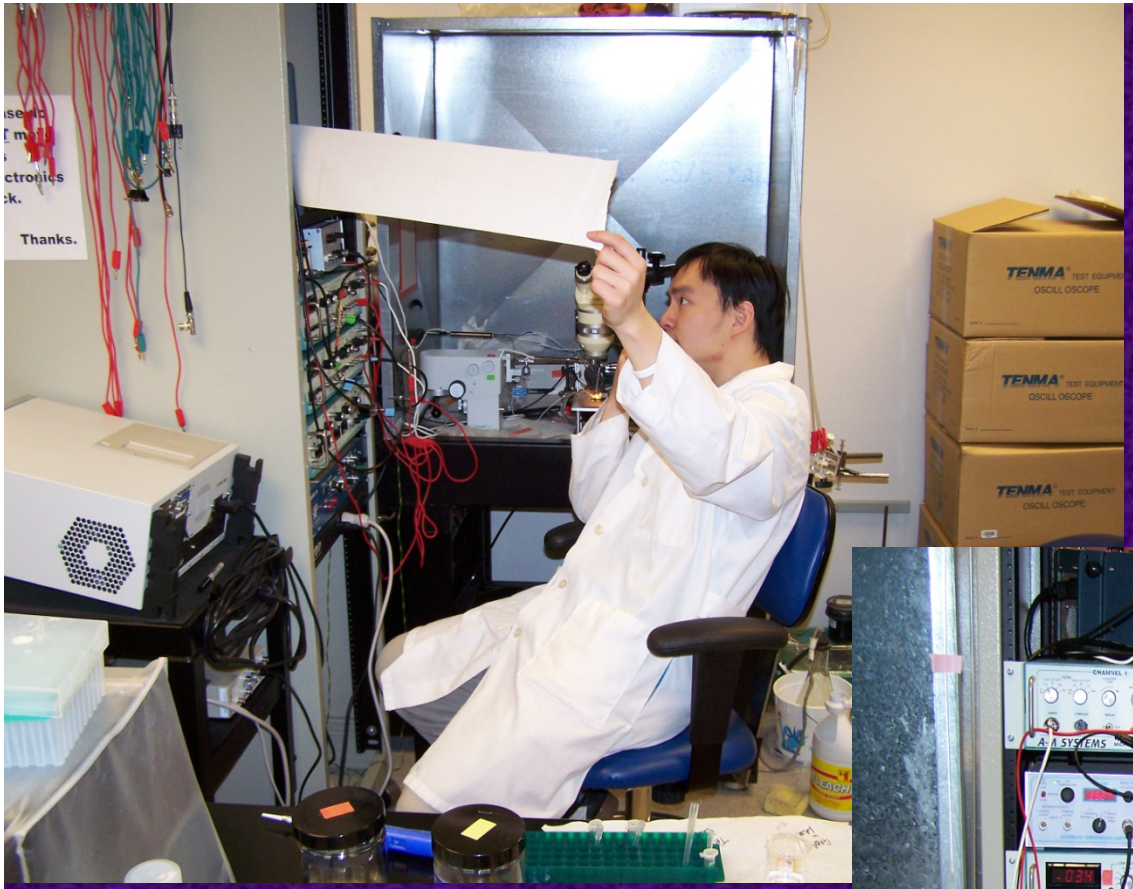


Karissa Carlson has completed her Ph.D. in biochemistry at the University of Iowa – Iowa City with work focused on the nature of DNA/gene damage involved in many diseases and how DNA repair enzymes work. She has returned to Northwestern College as a chemistry professor! (I'm getting old ☹)

Karissa presented our research at the annual Midwest Neurobiology Meeting

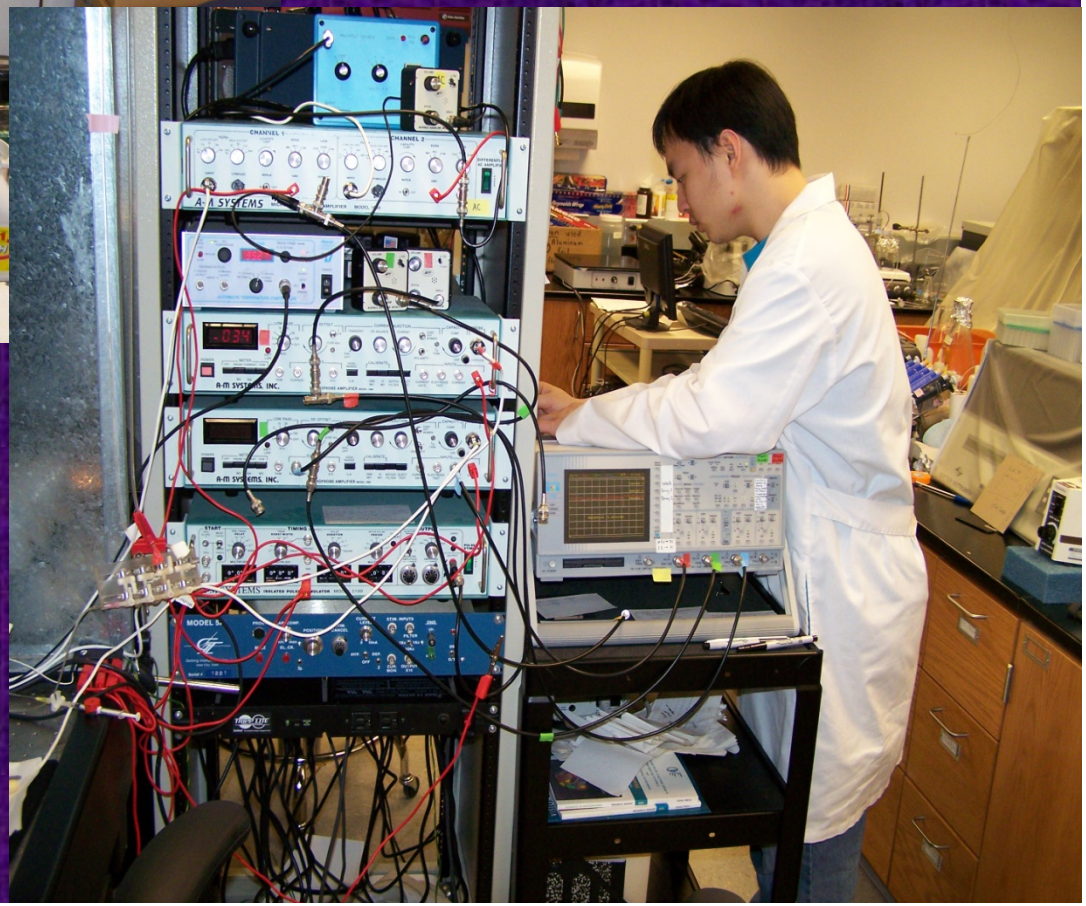


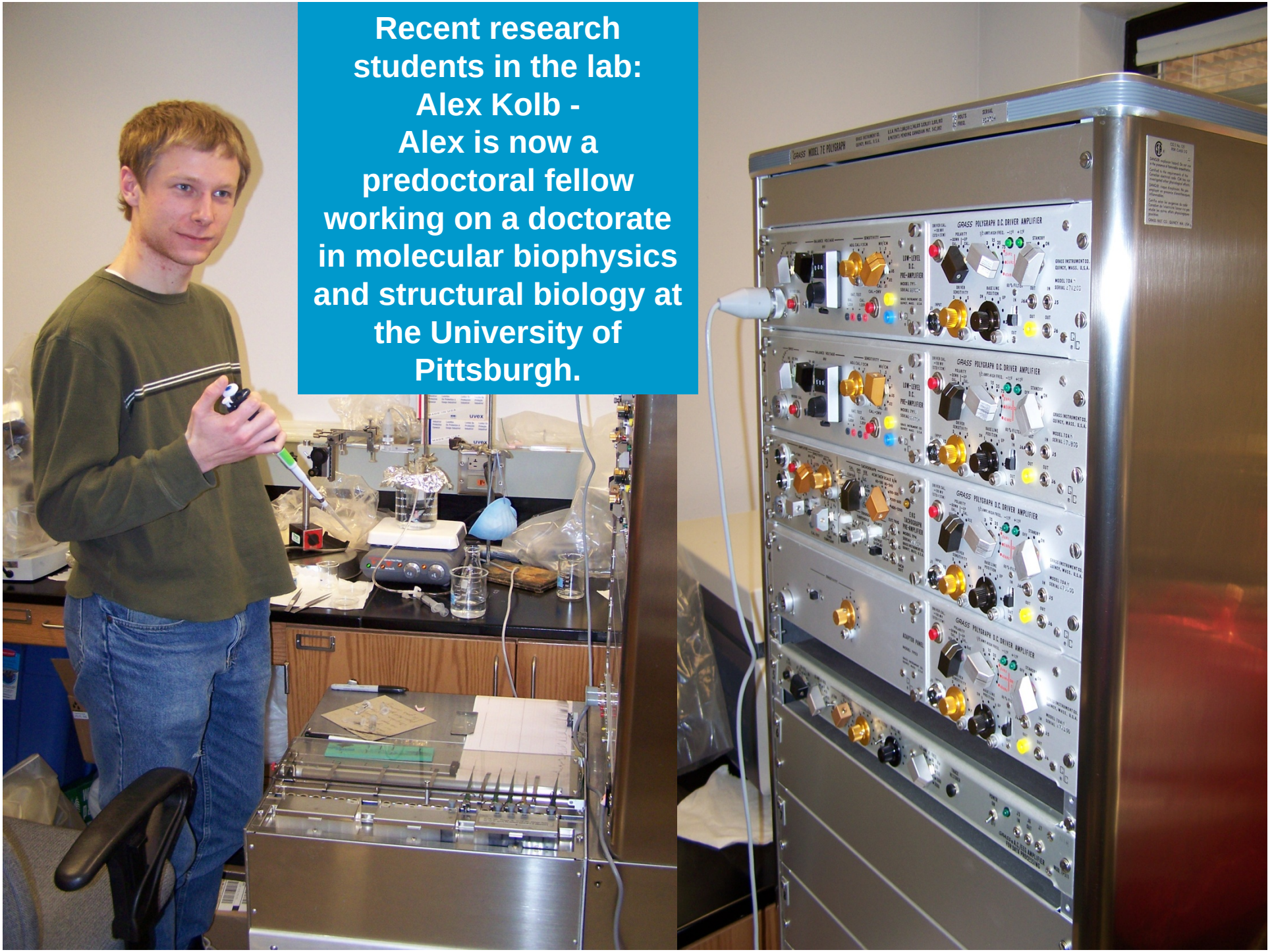
Recent research students in the lab:
Jason Helmus
After working for a year as the science/math lab coordinator at Pima Community College (Tucson AZ), Jason plans to pursue a doctorate in developmental biology.



Recent research students in the lab: Samuel Lim

Samuel hopes to enter medical school




Recent research students in the lab:
Alex Kolb -
Alex is now a predoctoral fellow working on a doctorate in molecular biophysics and structural biology at the University of Pittsburgh.

Educational/Community Outreach Activities

- Annual Brain Awareness Week (BAW) events:
  - Orange City Elementary School: annual hands-on school program about the brain for 5th grade science classes
  - Northwest Iowa High Schools (~5-6): annual "Morning (or Afternoon) of Neuroscience" fieldtrip by various biology classes to the neuroscience research lab here at NWC
  - These events involve age-level specific hands-on learning about neuroscience: e.g., model neurons, neurons under the microscope, sheep brain dissections, human brain models/slices & functional areas, EEG, intra- & extracellular electrophysiological recordings from neurons & muscles, career/vocation opportunities in neuroscience
- Northwestern Neuroscience Camp: one week summer residential neuroscience camp at NWC for outstanding high school students from across the country who are interested in neuroscience
- These outreach events involve service learning/mentoring opportunities for NWC college students in the NAPs program & neuroscience Honors/Directed Studies research students

NWC Neuroscience students have an opportunity to hear Dr. Emile Fernando, a neurosurgical physician's assistant at the Center for Neurscience, Orthopedics and Spine talk about the nature of brain surgery & the many careers in neuroscience-related fields...

Brain Awareness Day: Opportunities to learn about careers in neuroscience & to engage in service learning

Then the students are engaged in service learning as they present hands-on activities to the community demonstrating how the nervous system works

Brain Awareness Day events attract the community to learn about how the nervous system works. BAW events have been held at Northwestern or Dordt College or at public libraries. Neuroscience students have service learning opportunities to share what they have learned about how neuroscience affects our lives.

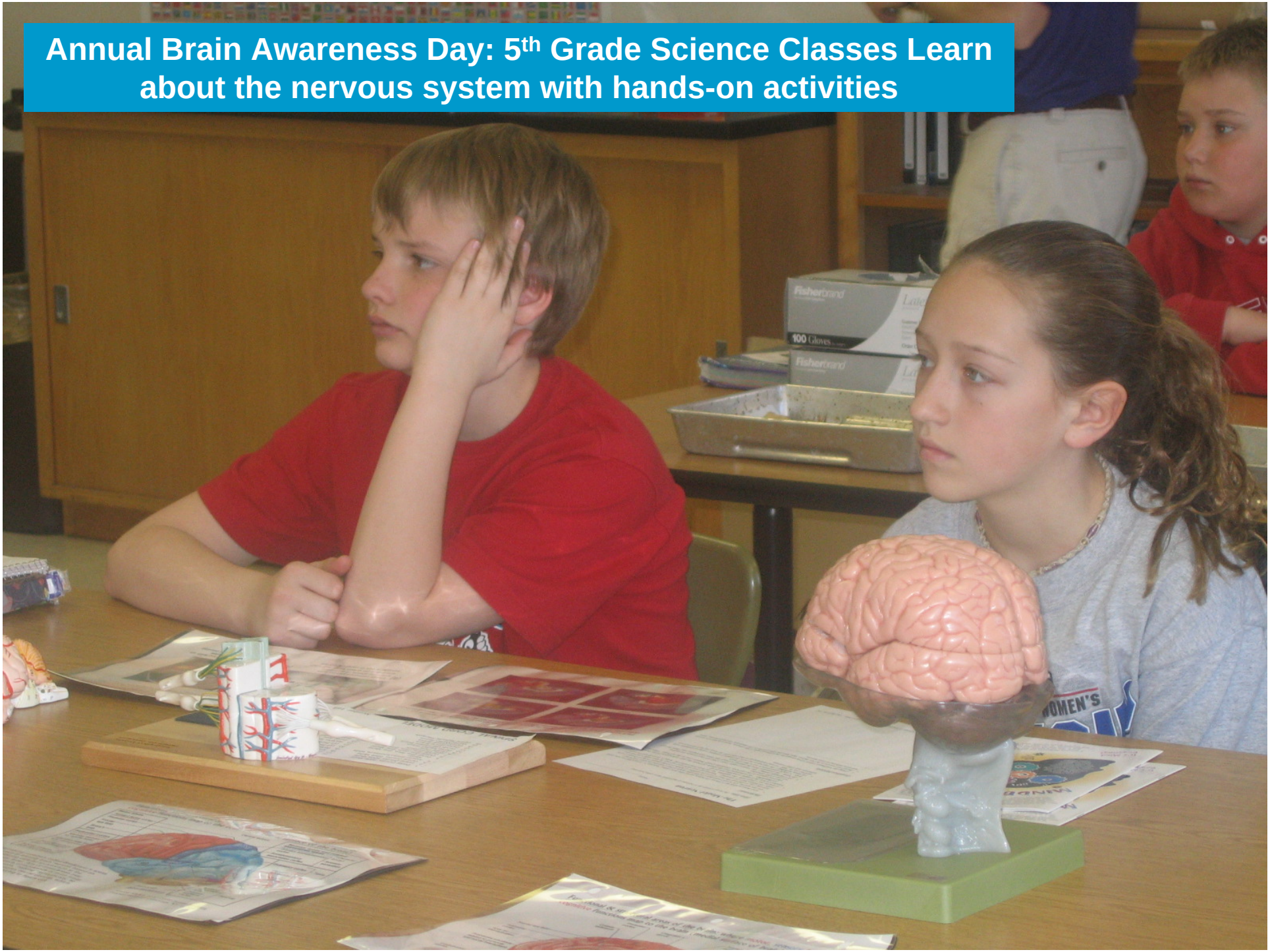
Brain Awareness Day at Orange City Elementary School

Mr. Te Grotenhuis' 5th Grade Science Classes

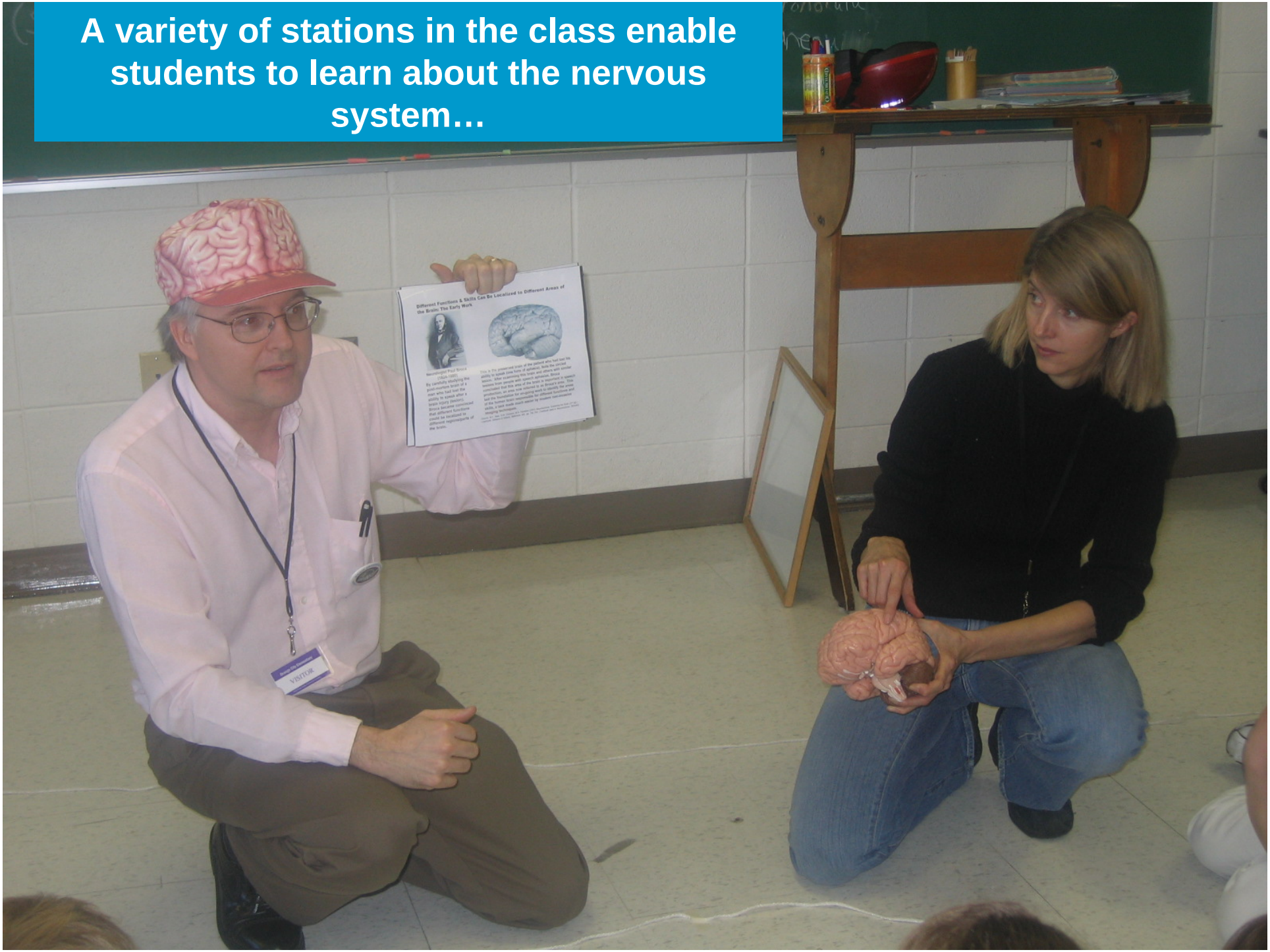
March 14, 2006
March 13, 2007
March 11, 2008
March 17, 2009

Sponsored by: the Neuroscience and Persons (NAPs) program

Annual Brain Awareness Day: 5th Grade Science Classes Learn about the nervous system with hands-on activities



A variety of stations in the class enable students to learn about the nervous system…

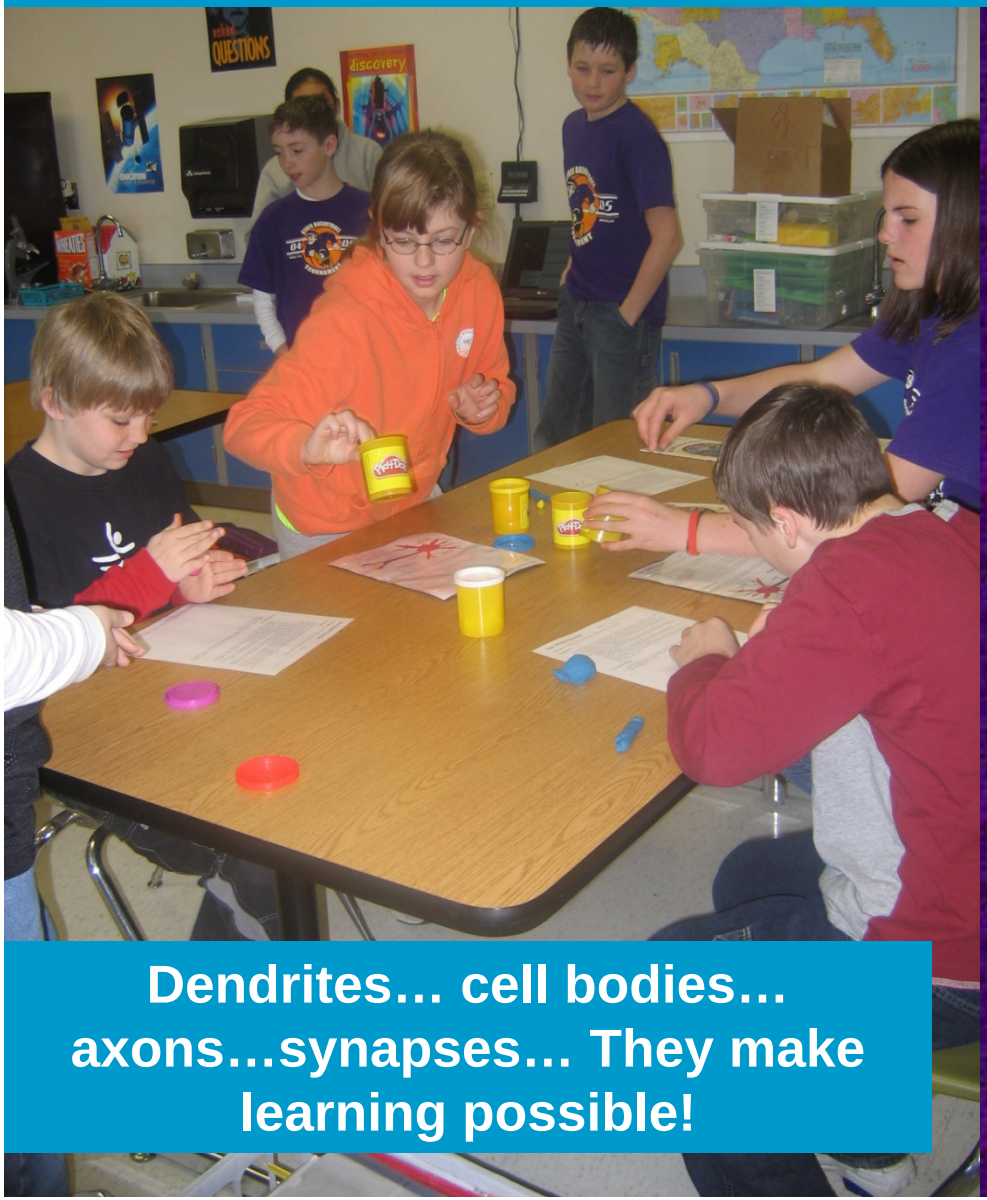


You have to use your brain to learn about the brain!

So how does it work when you are healthy?

What are some diseases of the brain?

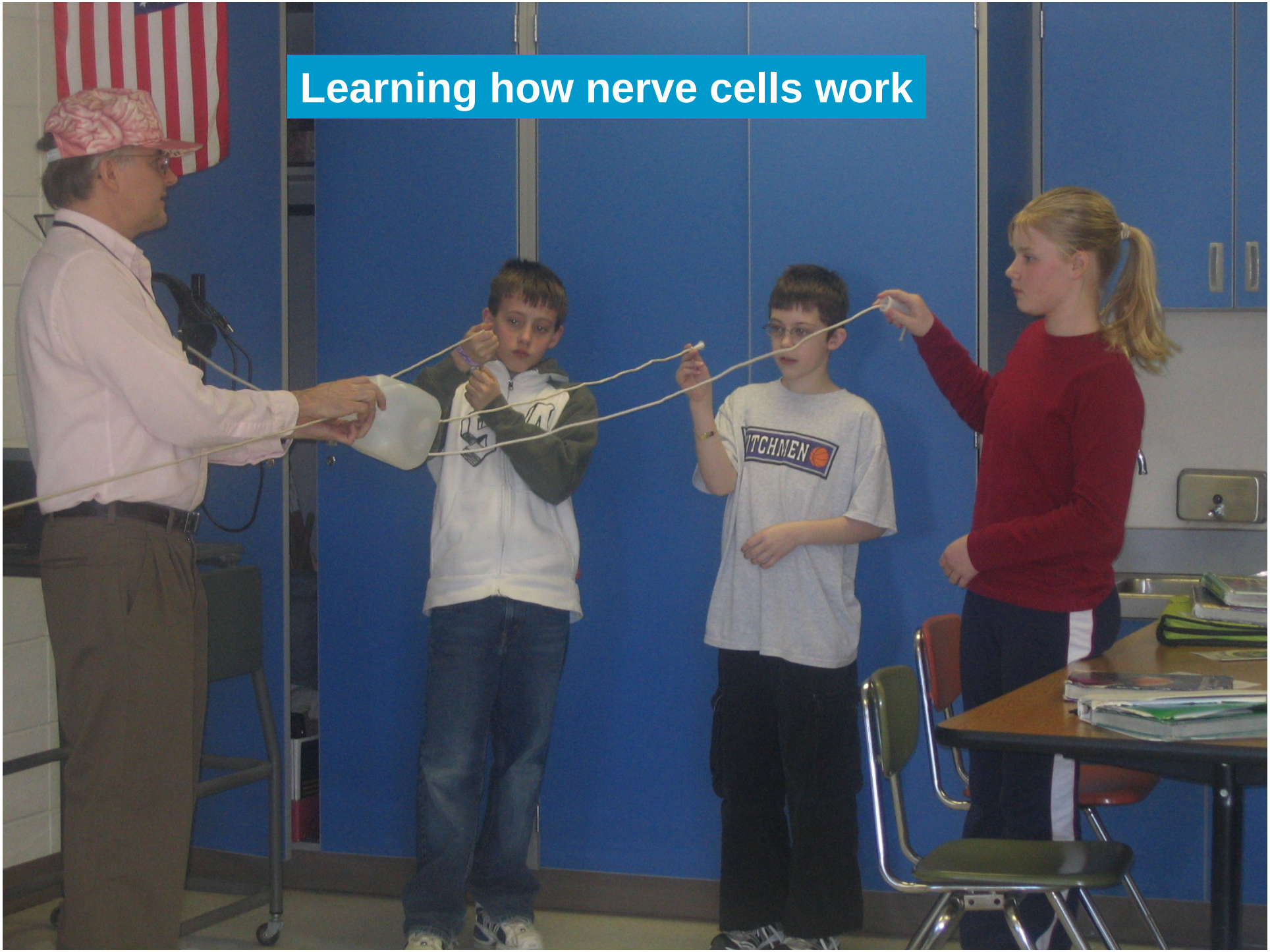
Making model neurons out of clay & learning their parts



Dendrites… cell bodies… axons…synapses… They make learning possible!

What do real neurons look like?

Let's check it out under the microscope!

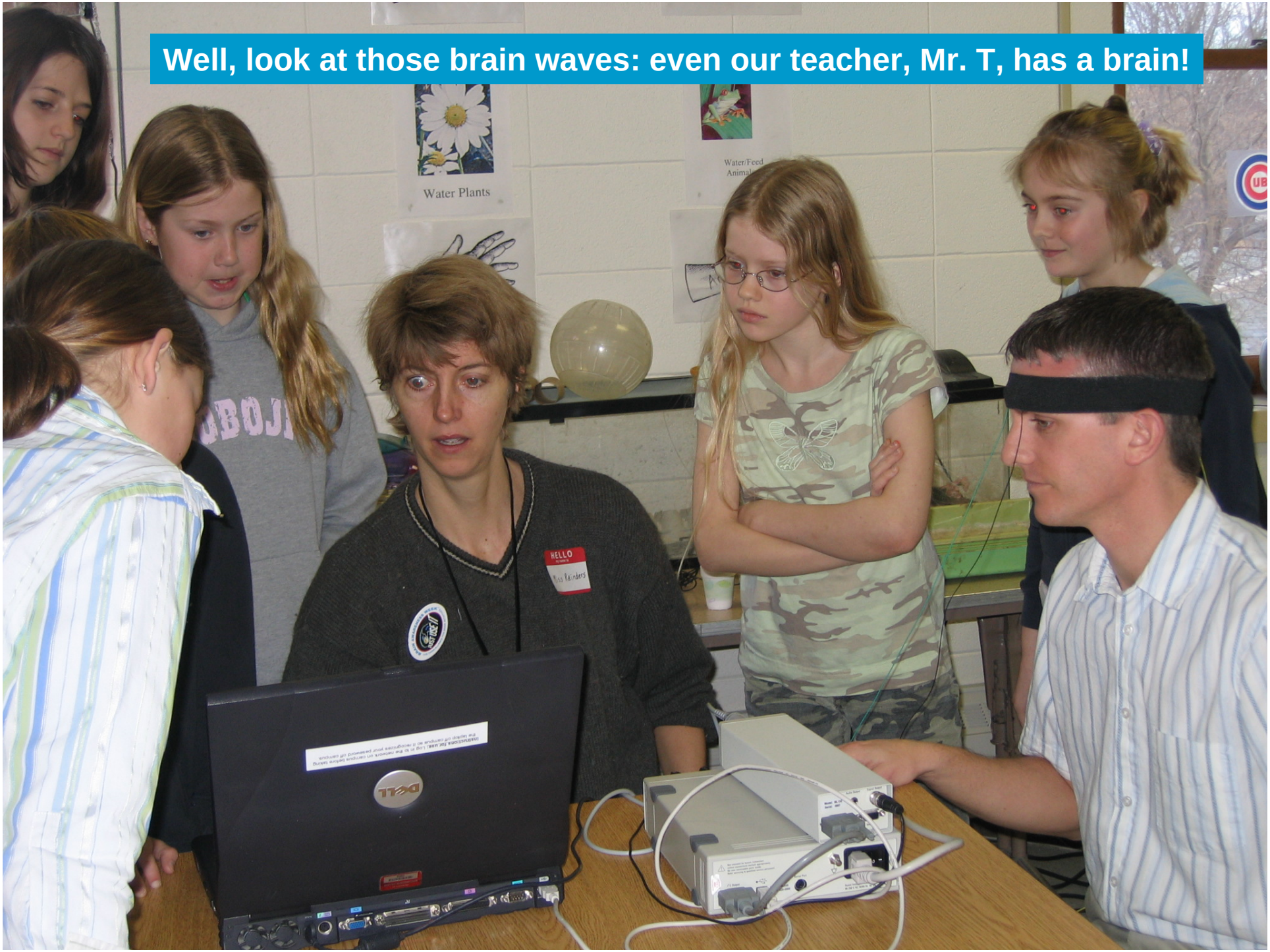

Learning how nerve cells work

Sheep brain dissections

So that’s what a real brain looks & feels like?

First we will listen to your pulse…

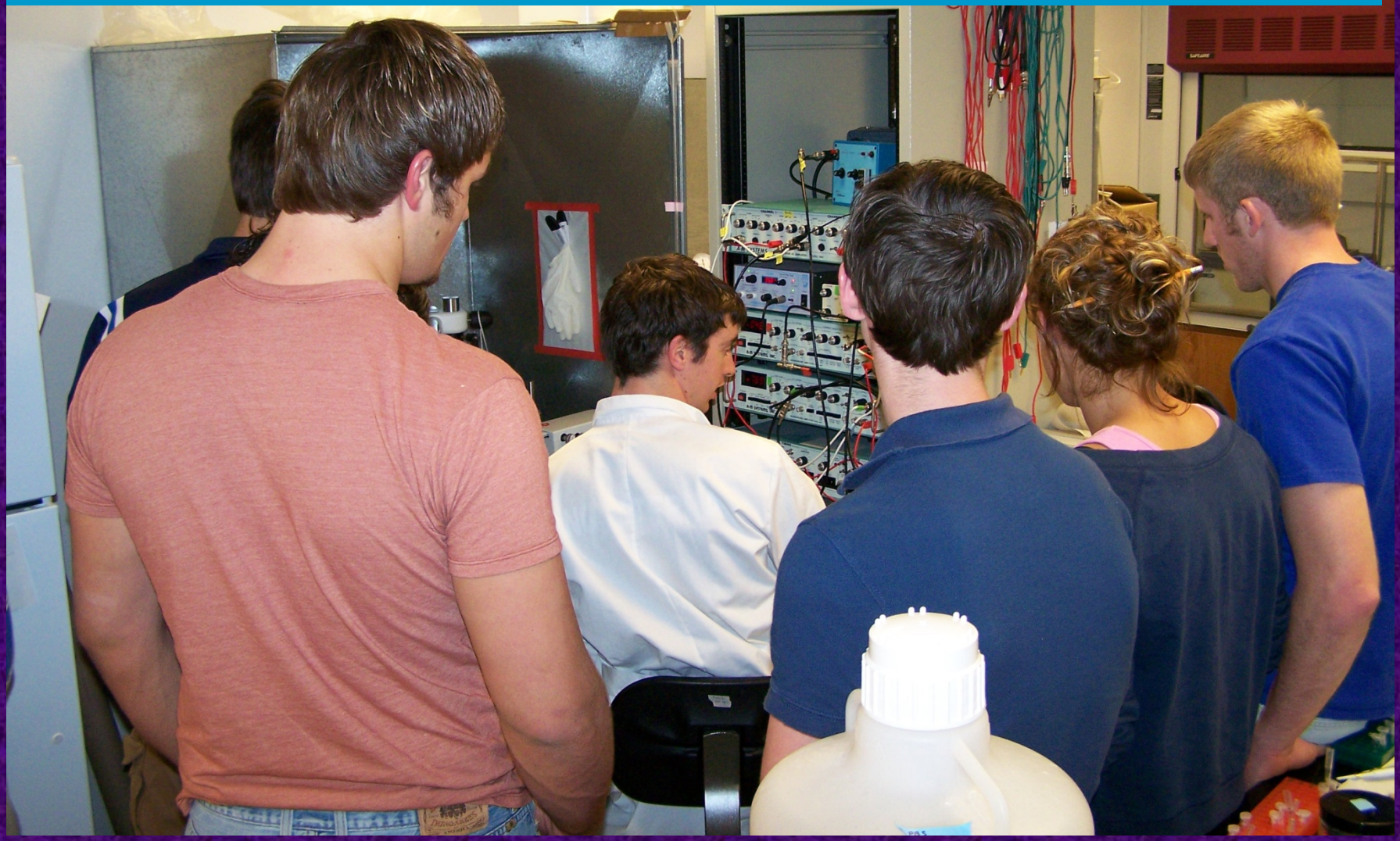
then we will check out the activity in your brain!


Well, look at those brain waves: even our teacher, Mr. T, has a brain!
Water Plants
HELLO
DELL

Another annual outreach event: "Mornings (or Afternoons) of Neuroscience"

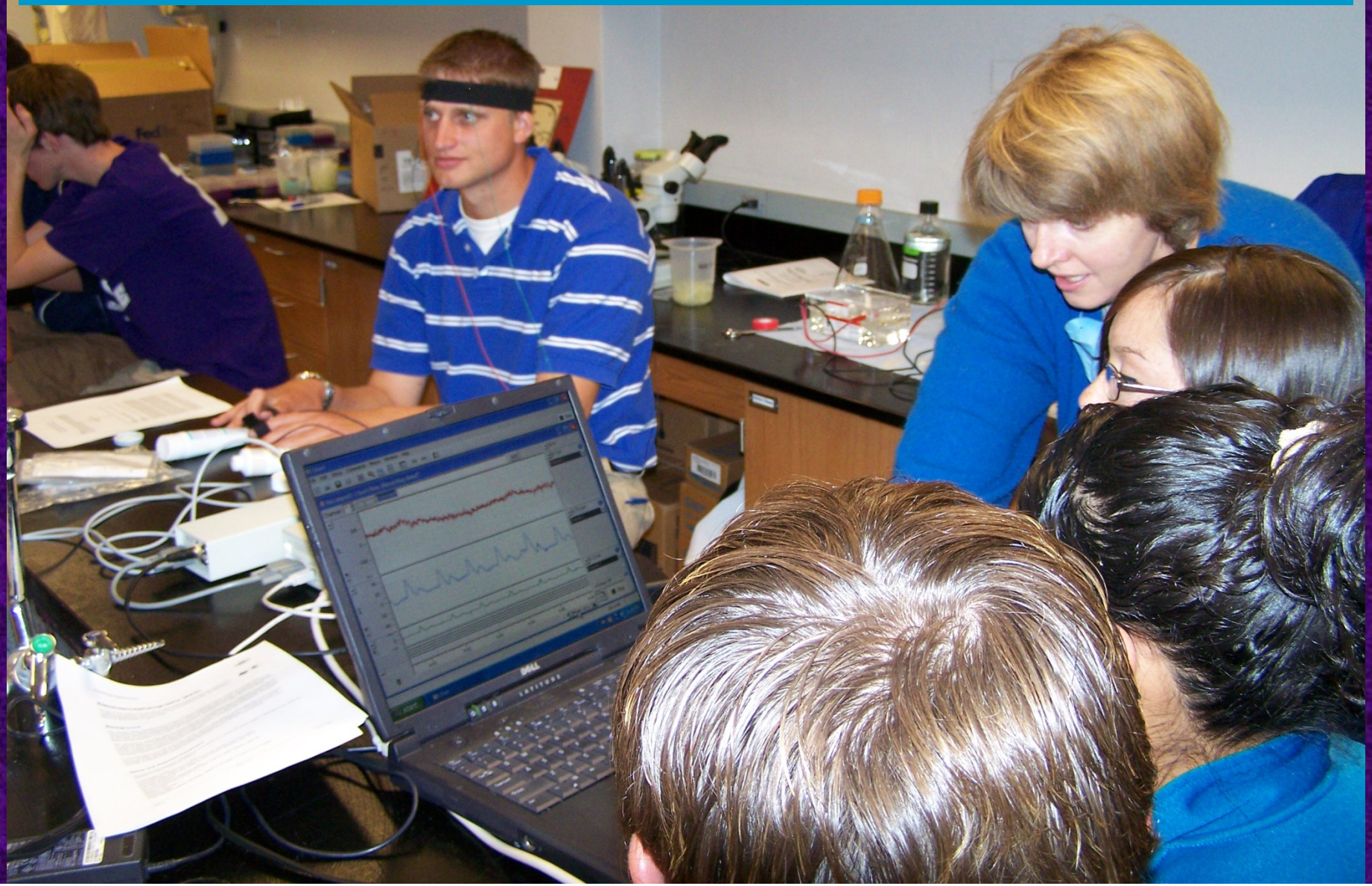
- High school students from area Human A&P and Advanced Biology classes spend half a day at the neuroscience research lab here at NWC to learn about neuroscience
- The importance of neuroscience research is highlighted
- Advances in neuroscience, neuroscience research techniques & career/vocation opportunities in neuroscience-related fields
- Hands-on activities include looking at neurons in the microscope, sheep brain dissections, electroencephalographic (EEG) brain recordings, examining the cadaver in our cadaver lab & other activities

Neuroscience Honors Research student, Jason Helmus, shows visiting advanced biology high school students how electrophysiology experiments are done.

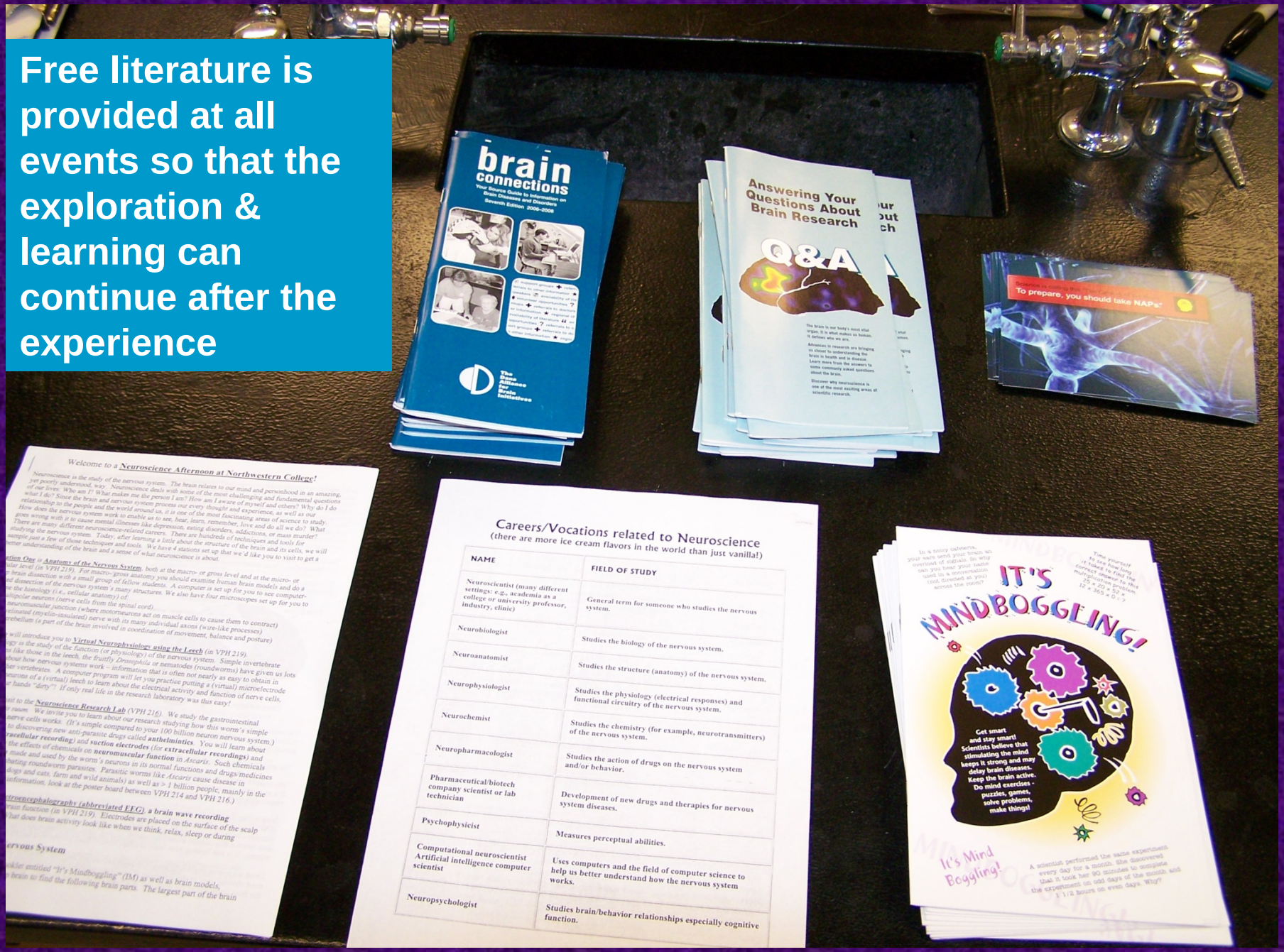


The high school students examine multipolar neurons, neuromuscular junctions, and different areas of the brain and spinal cord in the microscope.

Students monitor the pulse and brain wave (EEG) activity of their biology teacher. What do you know – even high school biology teachers have complex brain activity. I wonder what he is thinking.



Free literature is provided at all events so that the exploration & learning can continue after the experience



Northwestern Neuroscience Camp (NNC)

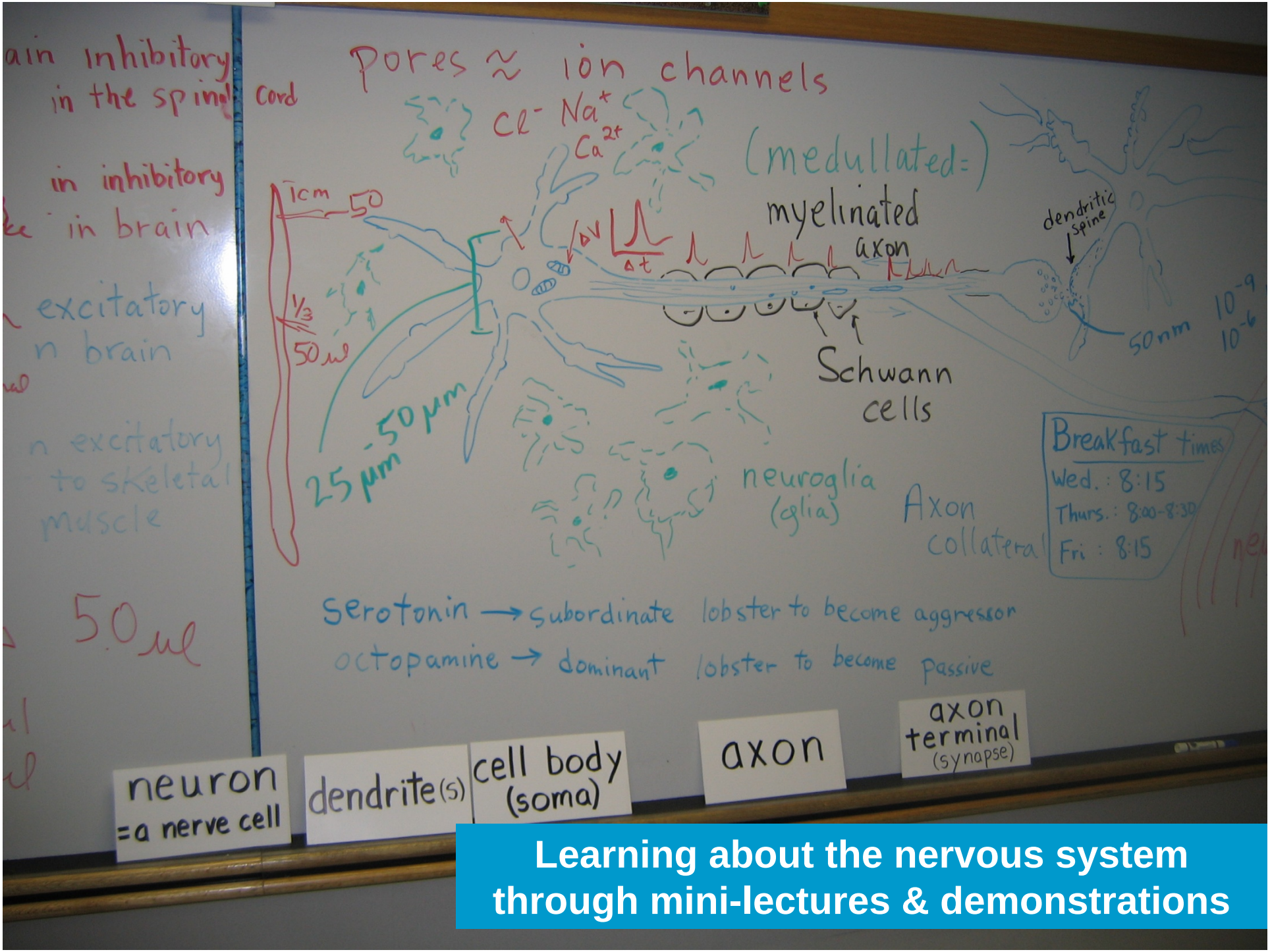
1St Annual Camp: June 5-9, 2006
2nd Annual Camp: June 4-8, 2007
3rd Annual Camp: June 9-13 & 16-20, 2008
4th Annual Camp: June 15-19 & 22-26, 2009

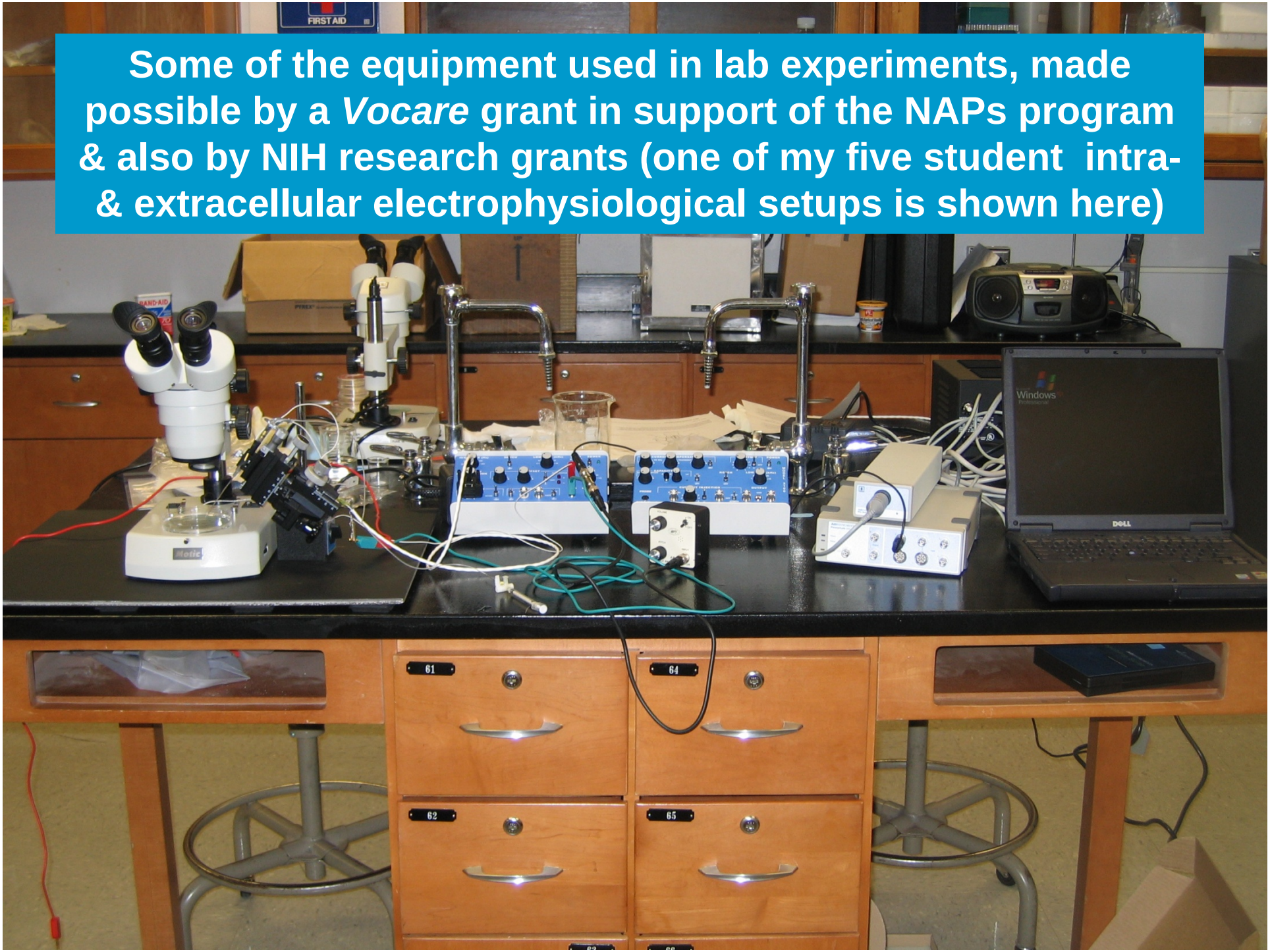
Sponsored by:

The Neuroscience and Persons (NAPs) program & *Vocare*: Find Your Place program at Northwestern College

Another outreach event: Northwestern Neuroscience Camp (NNC)

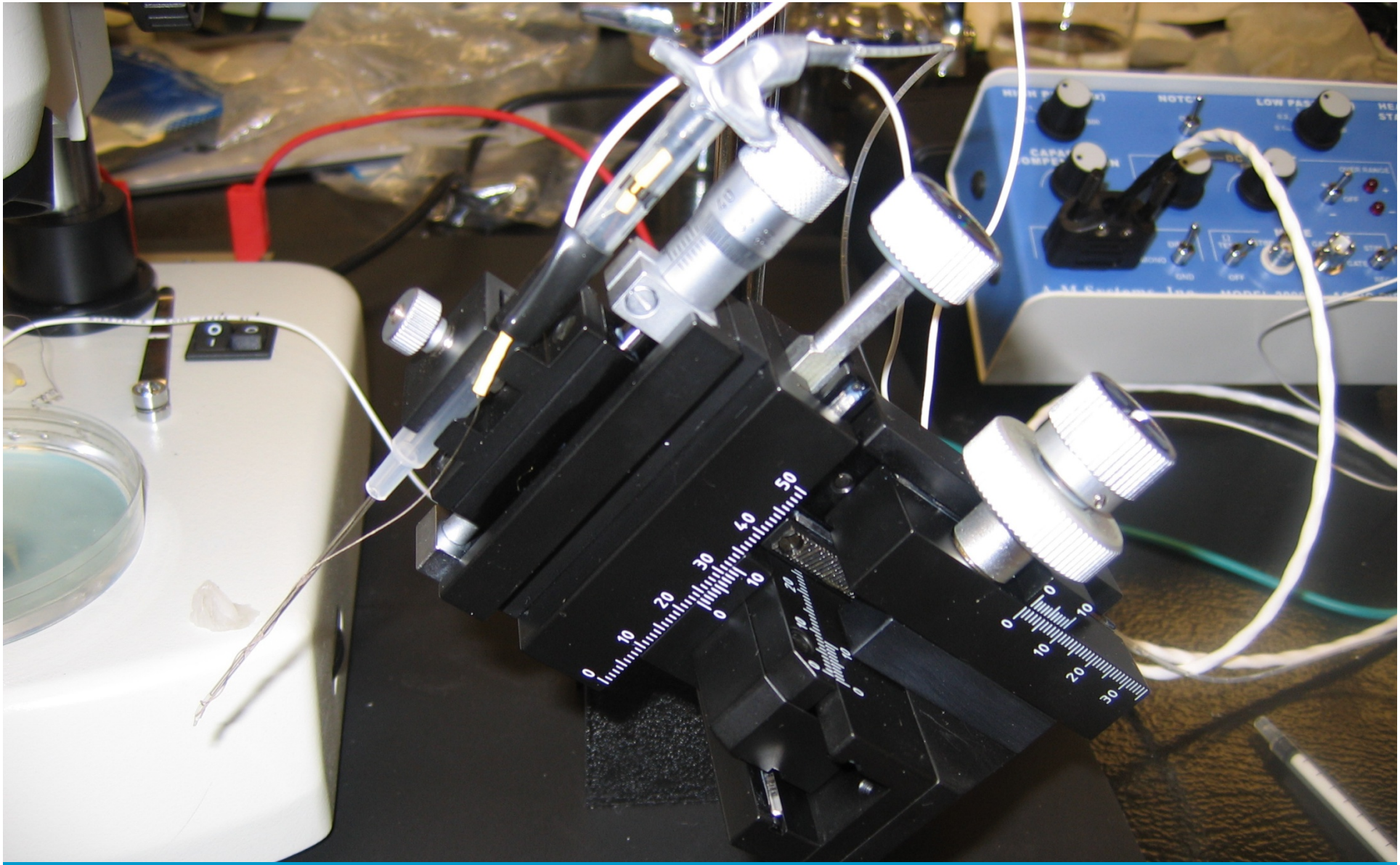
- Goal of the NNC - introduces:
  - Excitement & cutting-edge nature of neuroscience
    - "The Century of Neuroscience, the Century of the Brain"
  - Wide variety of careers/vocations in neuroscience
  - Taste of college life, recruitment to NAPs program
- Introduces 10-15 outstanding high school students interested in biology to neuroscience
  - Mini-lectures, demonstrations in the mornings; mainly hands-on lab experiments in the afternoons
- Involves one week stay here on campus
  - Service learning: NAPs/neuroscience students serve as mentors & chaperones


Pores ≈ ion channels
Cl⁻ Na⁺ Ca²⁺
(medullated=)
myelinated axon
dendritic spine
Schwann cells
neuroglia (glia)
Axon collateral
1cm
50
1/3
50 μ
25 μm
50 μm
50nm
Breakfast times
Wed. : 8:15
Thurs. : 8:00-8:30
Fri : 8:15
Serotonin → subordinate lobster to become aggressor
octopamine → dominant lobster to become passive
neuron =a nerve cell
dendrite(s)
cell body (soma)
axon
axon terminal (synapse)
Learning about the nervous system through mini-lectures & demonstrations



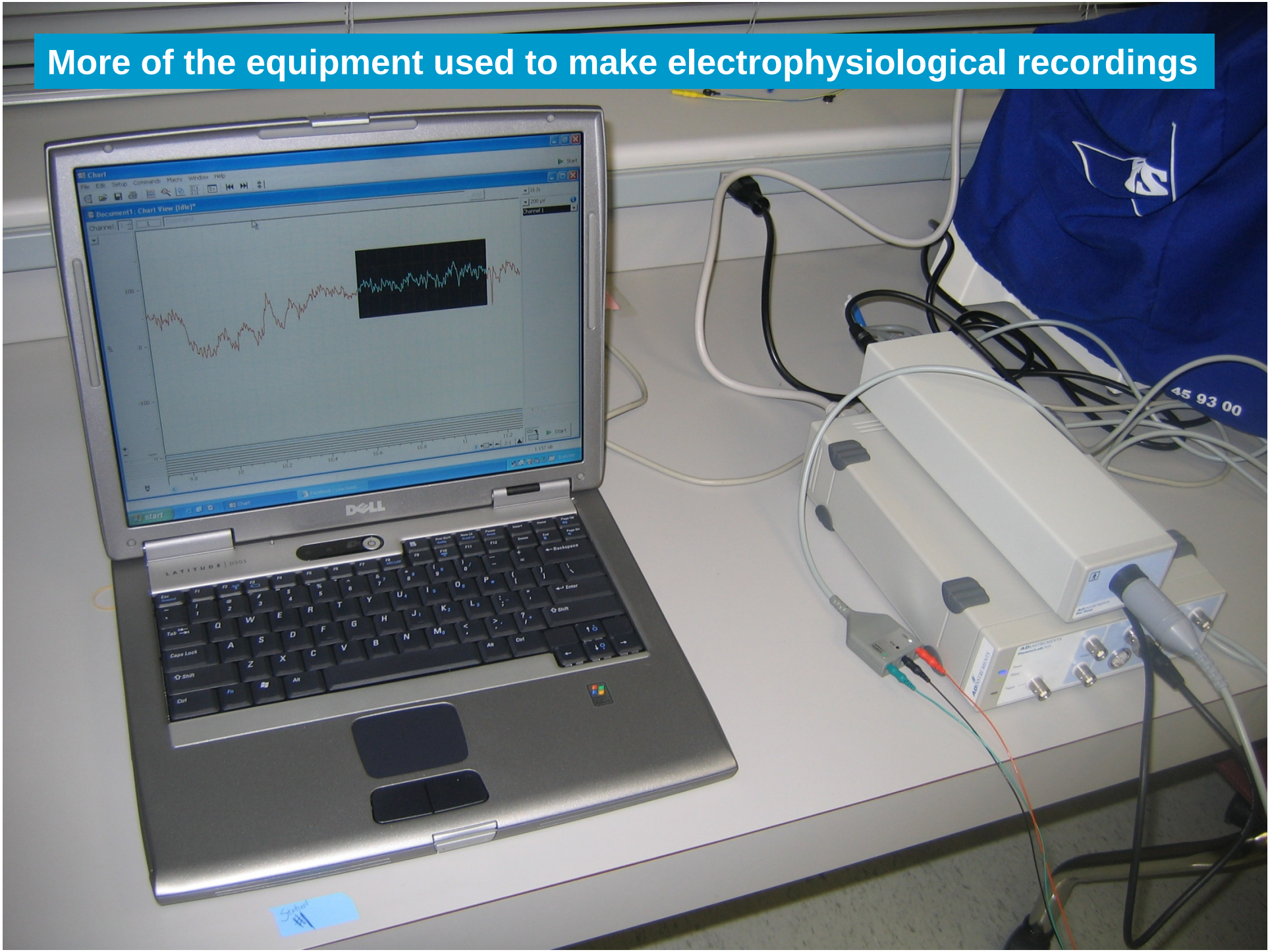
Some of the equipment used in lab experiments, made possible by a *Vocare* grant in support of the NAPs program & also by NIH research grants (one of my five student intra- & extracellular electrophysiological setups is shown here)

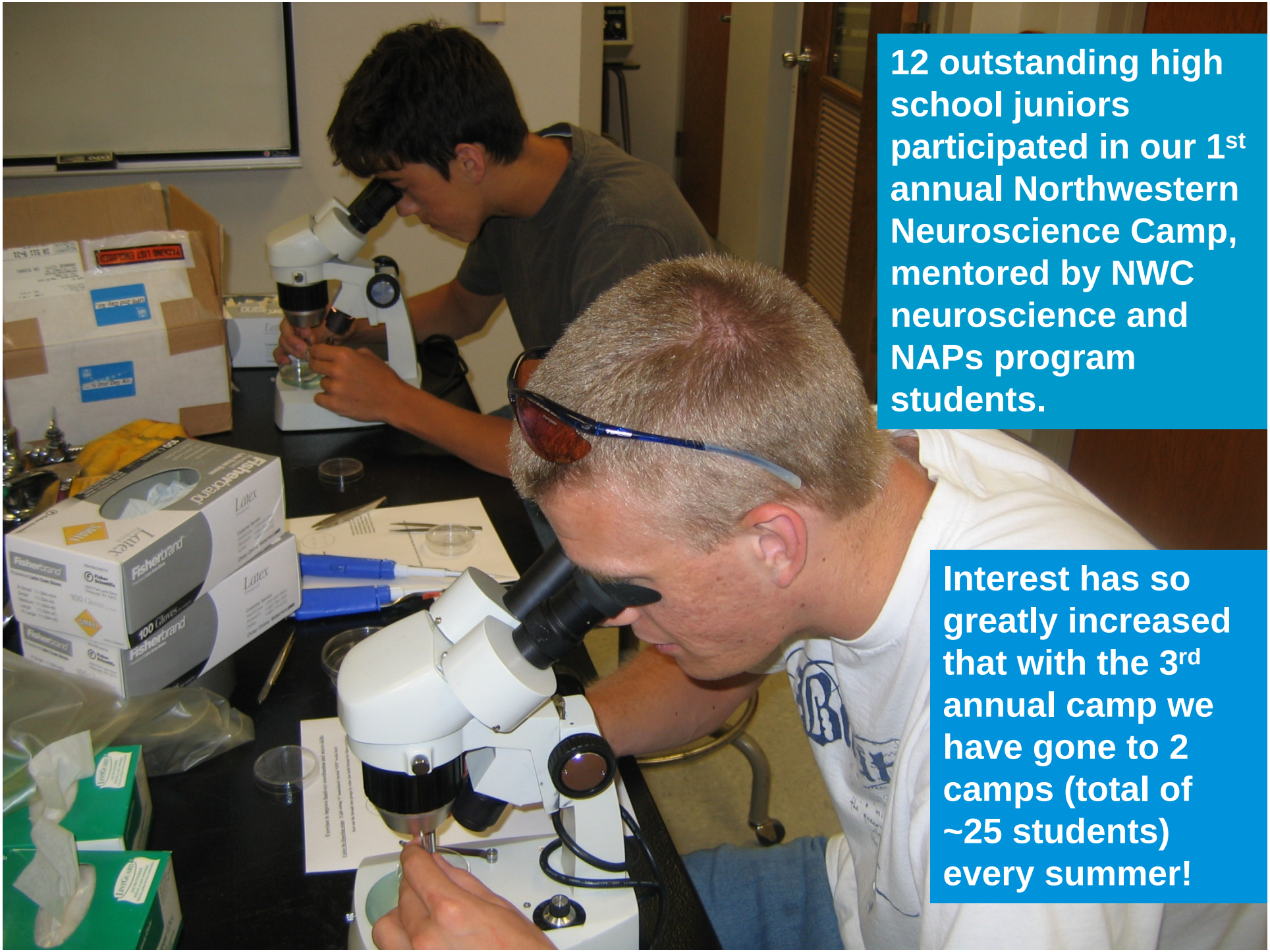

Some of the equipment/supplies used, again made possible by a Vocare grant to the NAPs program & NIH research grants



The neuroscience equipment gets used in multiple settings associated with the NAPs program: the core neuroscience course & lab, the Northwestern Neuroscience Camp, Brain Awareness Week events, other outreach events, etc.

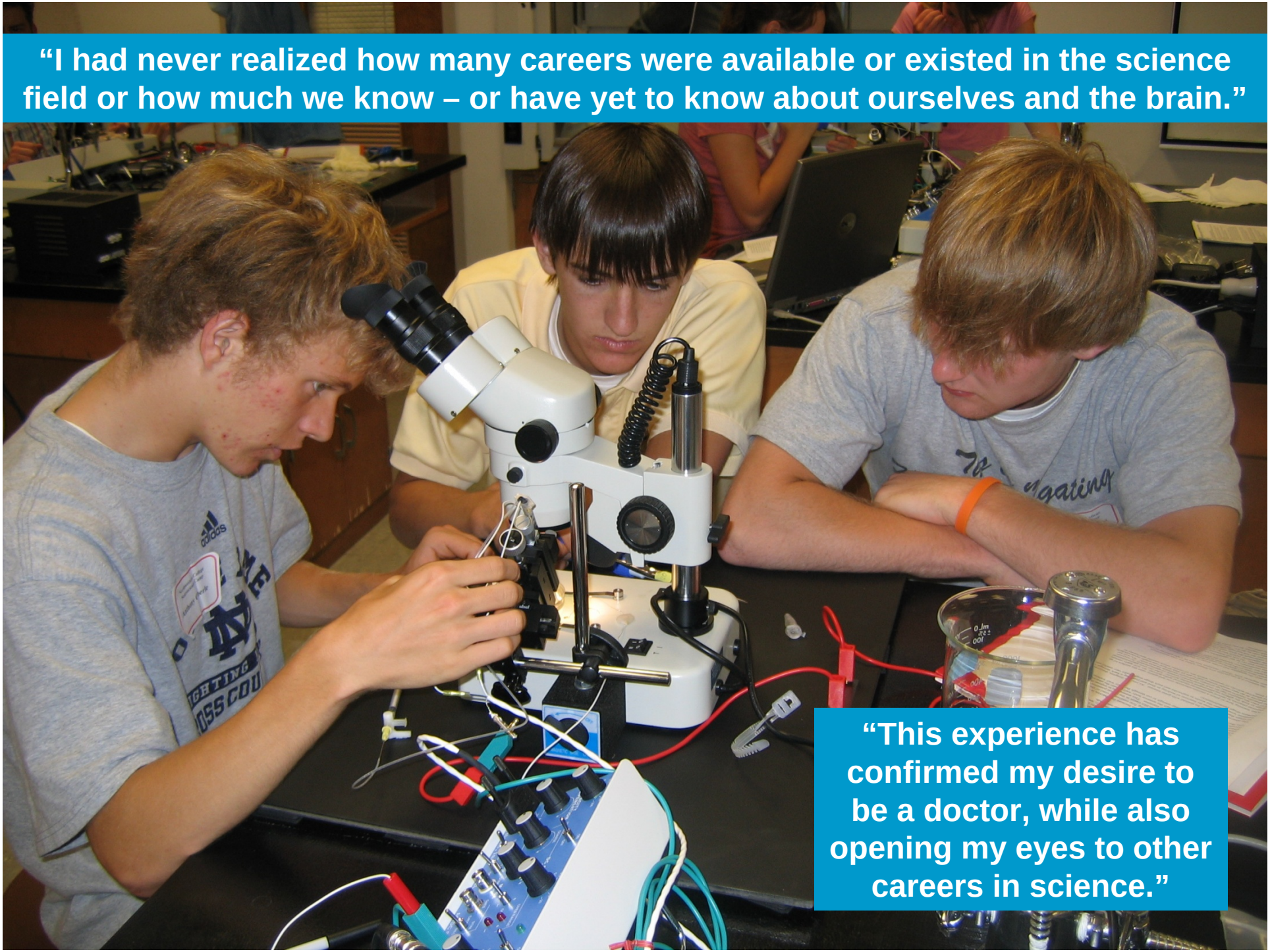
More of the equipment used to make electrophysiological recordings

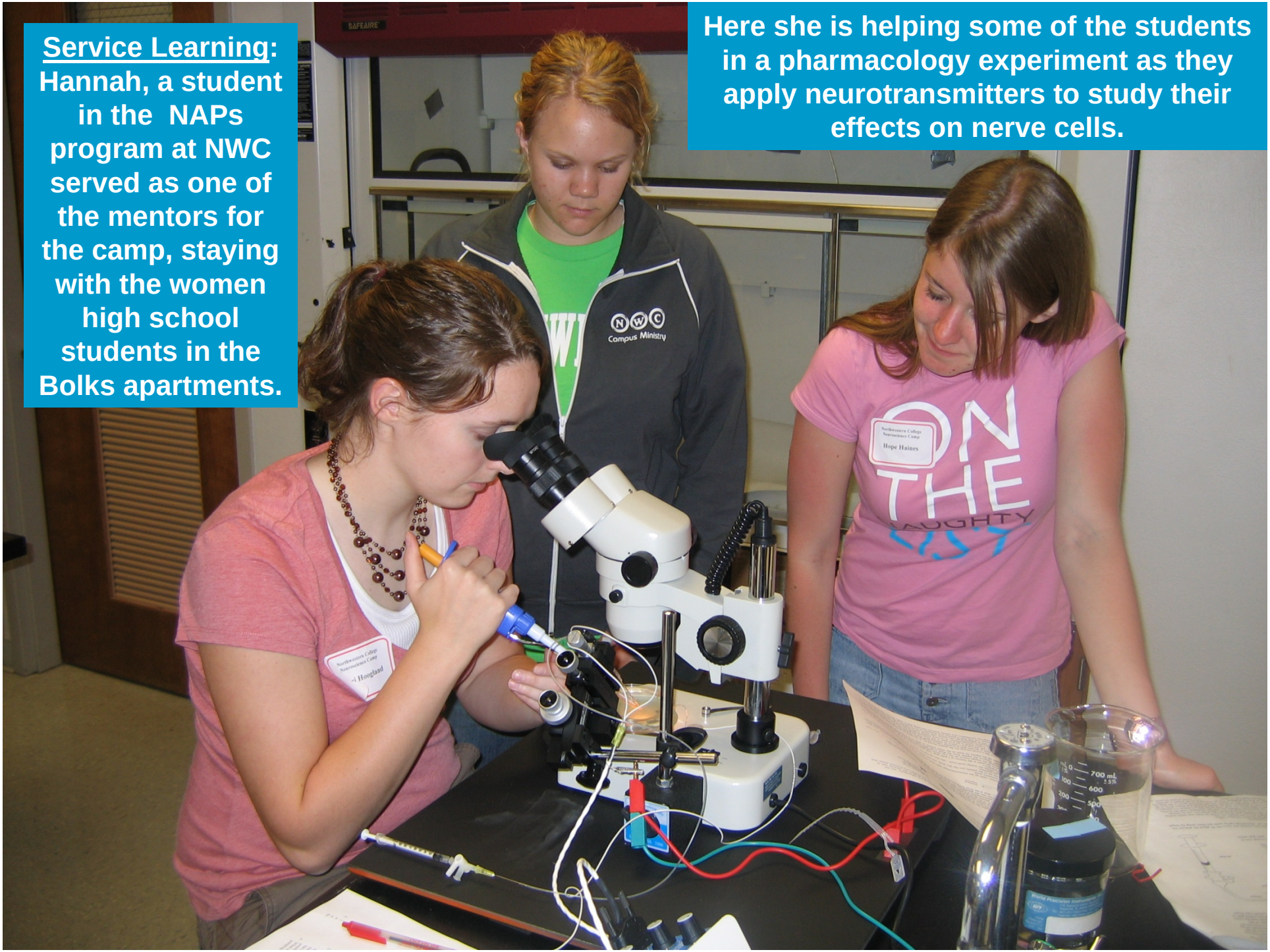


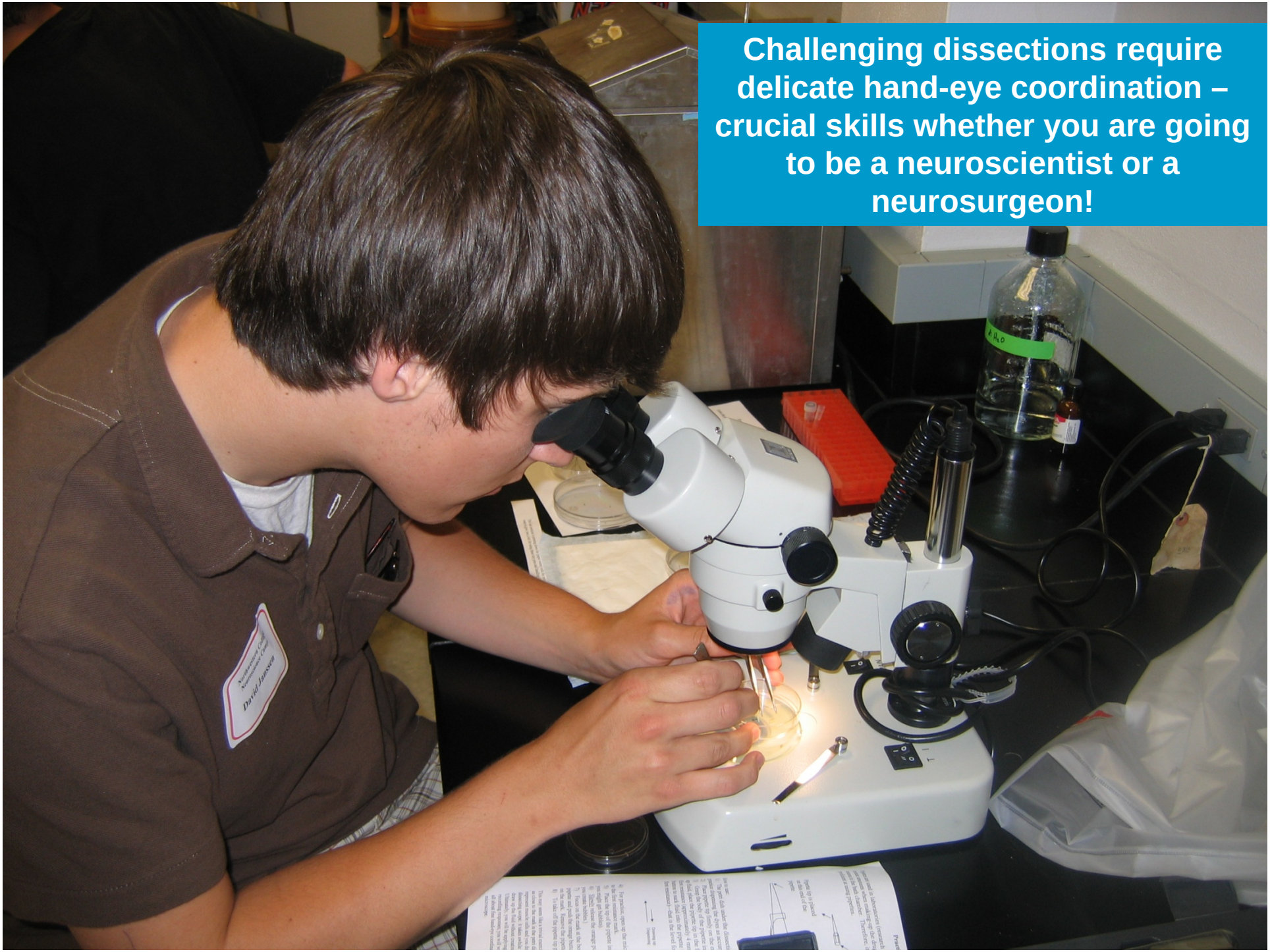


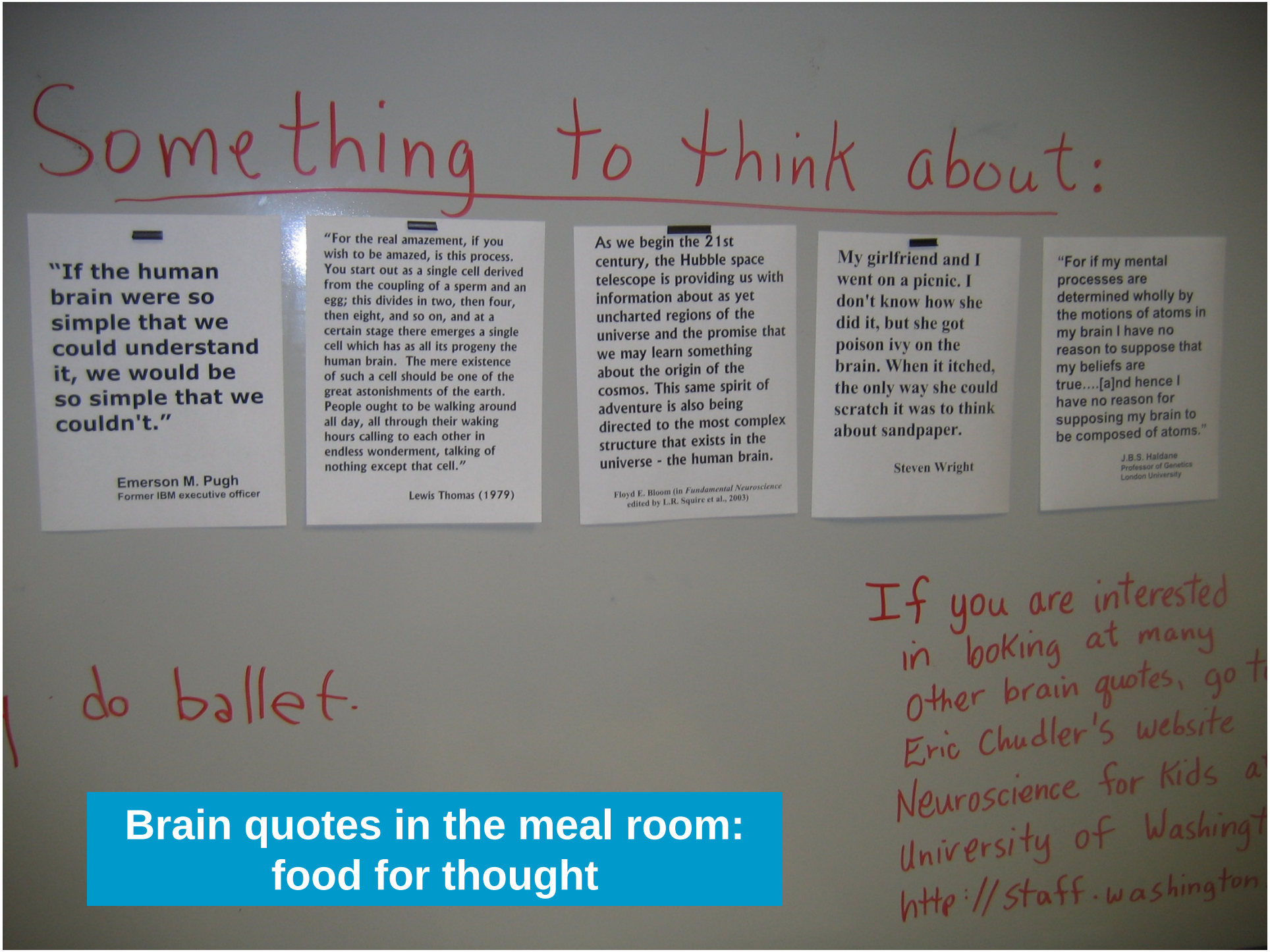
12 outstanding high school juniors participated in our 1st annual Northwestern Neuroscience Camp, mentored by NWC neuroscience and NAPs program students.

Interest has so greatly increased that with the 3rd annual camp we have gone to 2 camps (total of ~25 students) every summer!


“I had never realized how many careers were available or existed in the science field or how much we know – or have yet to know about ourselves and the brain.”
“This experience has confirmed my desire to be a doctor, while also opening my eyes to other careers in science.”


Service Learning: Hannah, a student in the NAPs program at NWC served as one of the mentors for the camp, staying with the women high school students in the Bolks apartments.
Here she is helping some of the students in a pharmacology experiment as they apply neurotransmitters to study their effects on nerve cells.
Campus Ministry
Hope Haines


Challenging dissections require delicate hand-eye coordination – crucial skills whether you are going to be a neuroscientist or a neurosurgeon!



Brain quotes in the meal room: food for thought

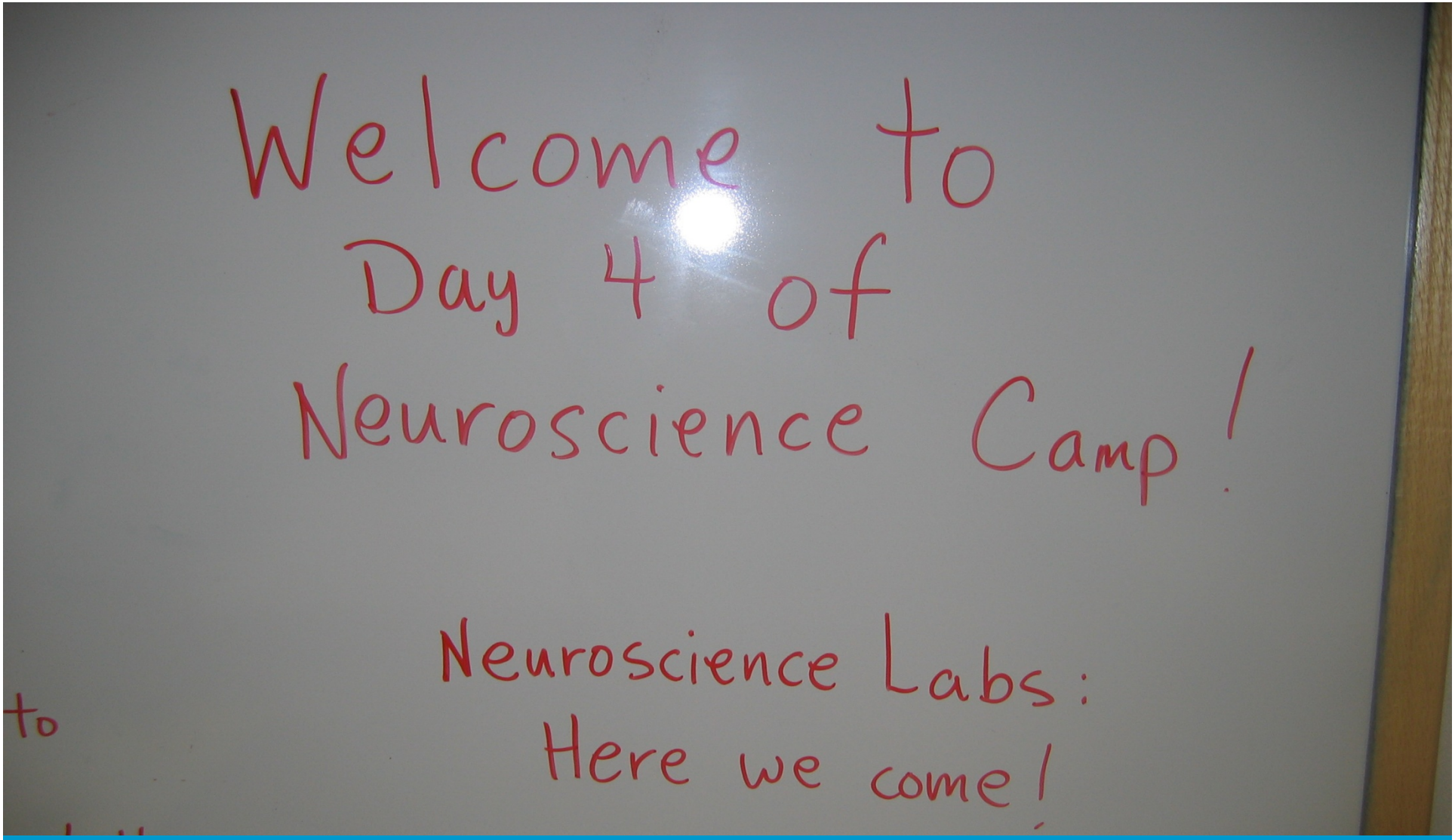
Locally catered meals:
What did the students think?

"Meals were delicious & varied."
"I loved all the food."
"Awesome food, I was pleasantly surprised."

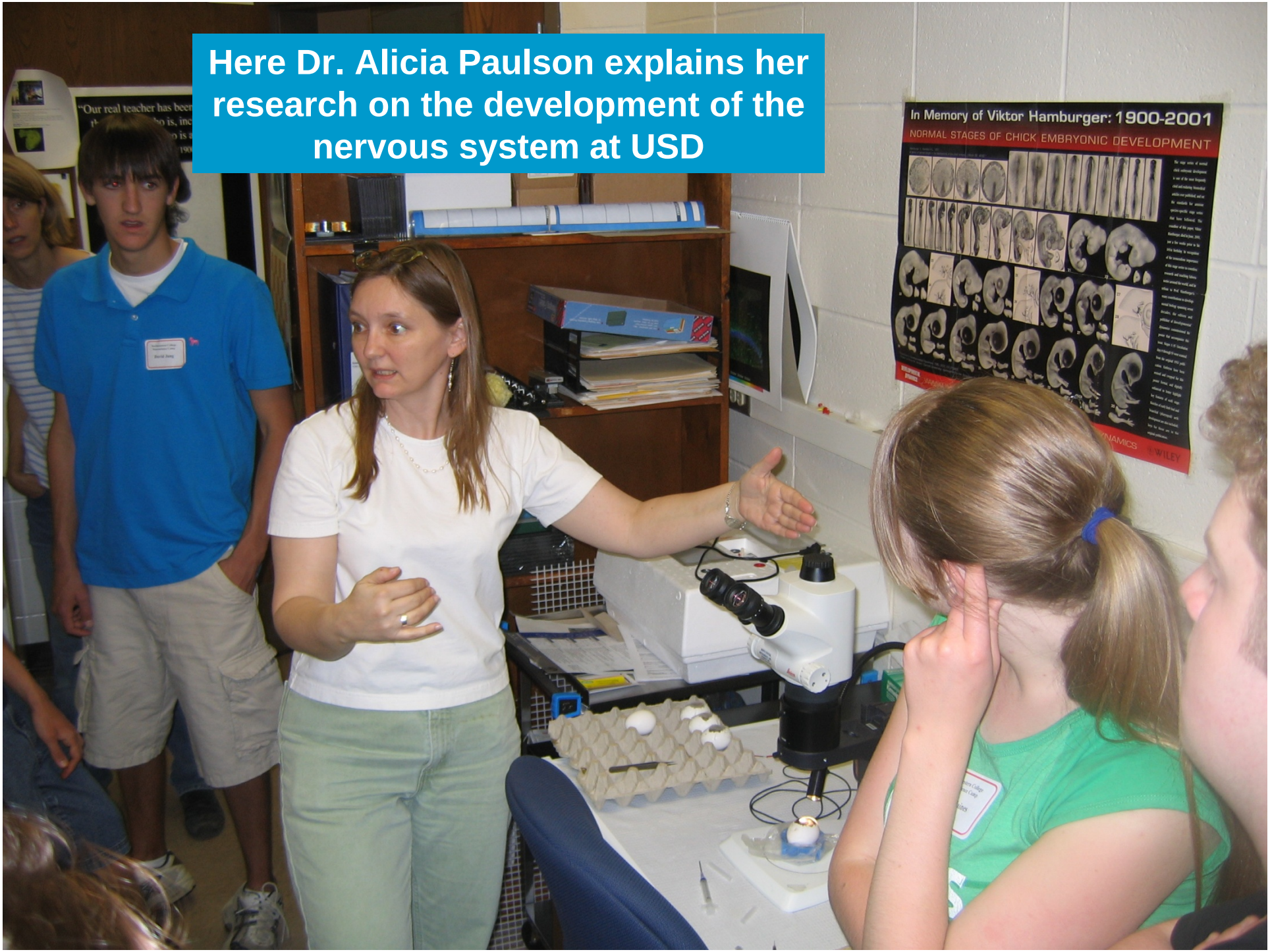
A down side? "Gaining 10 lbs."

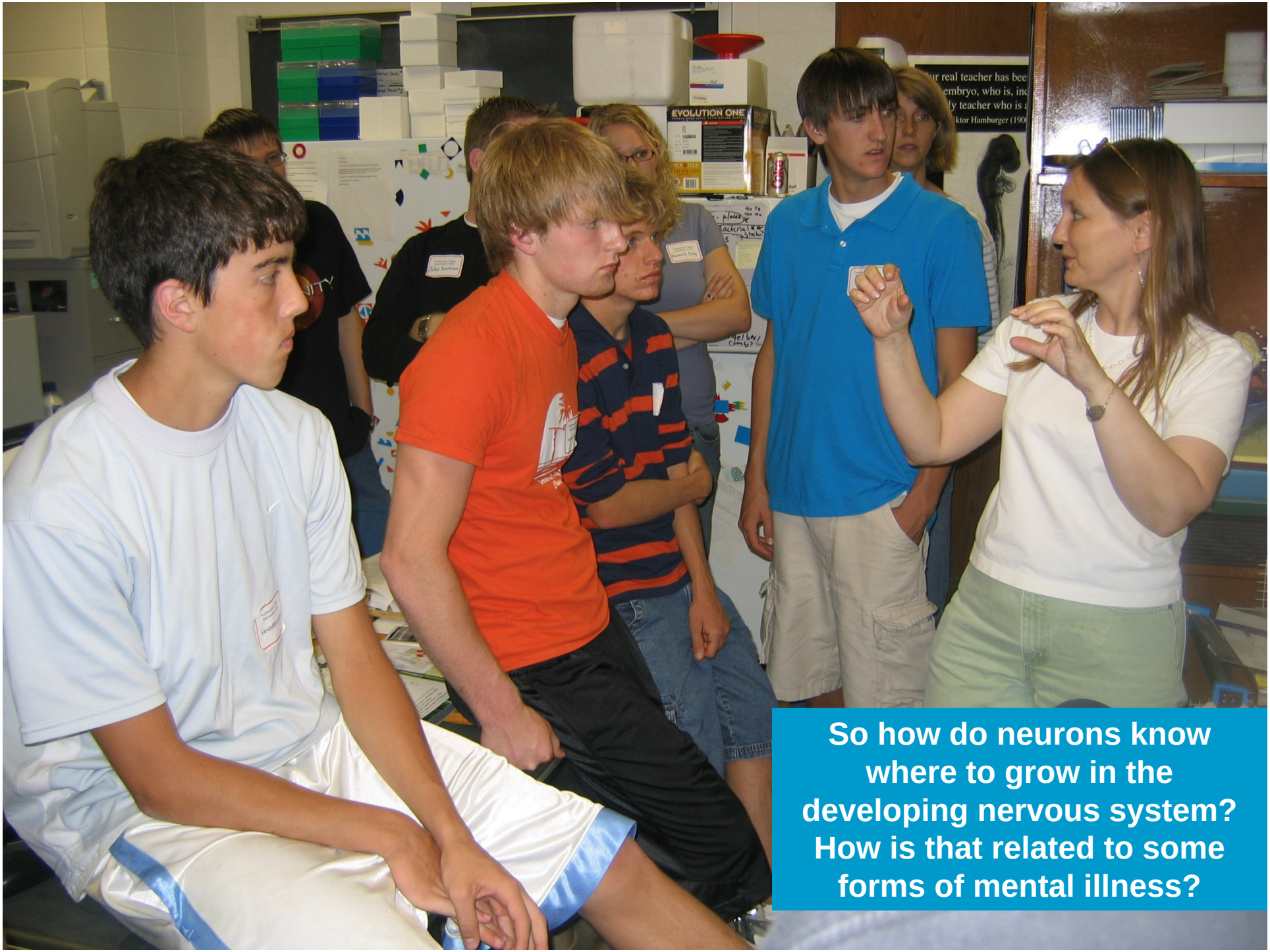
Meals were great times to talk over what we were learning in the neuroscience lab & the general fun we were having. Some “favorite parts:” “Doing labs and being treated like a college student” “The labs were awesome!” “USD trip” “Cadaver lab” “The EEG” “Labs were great!”

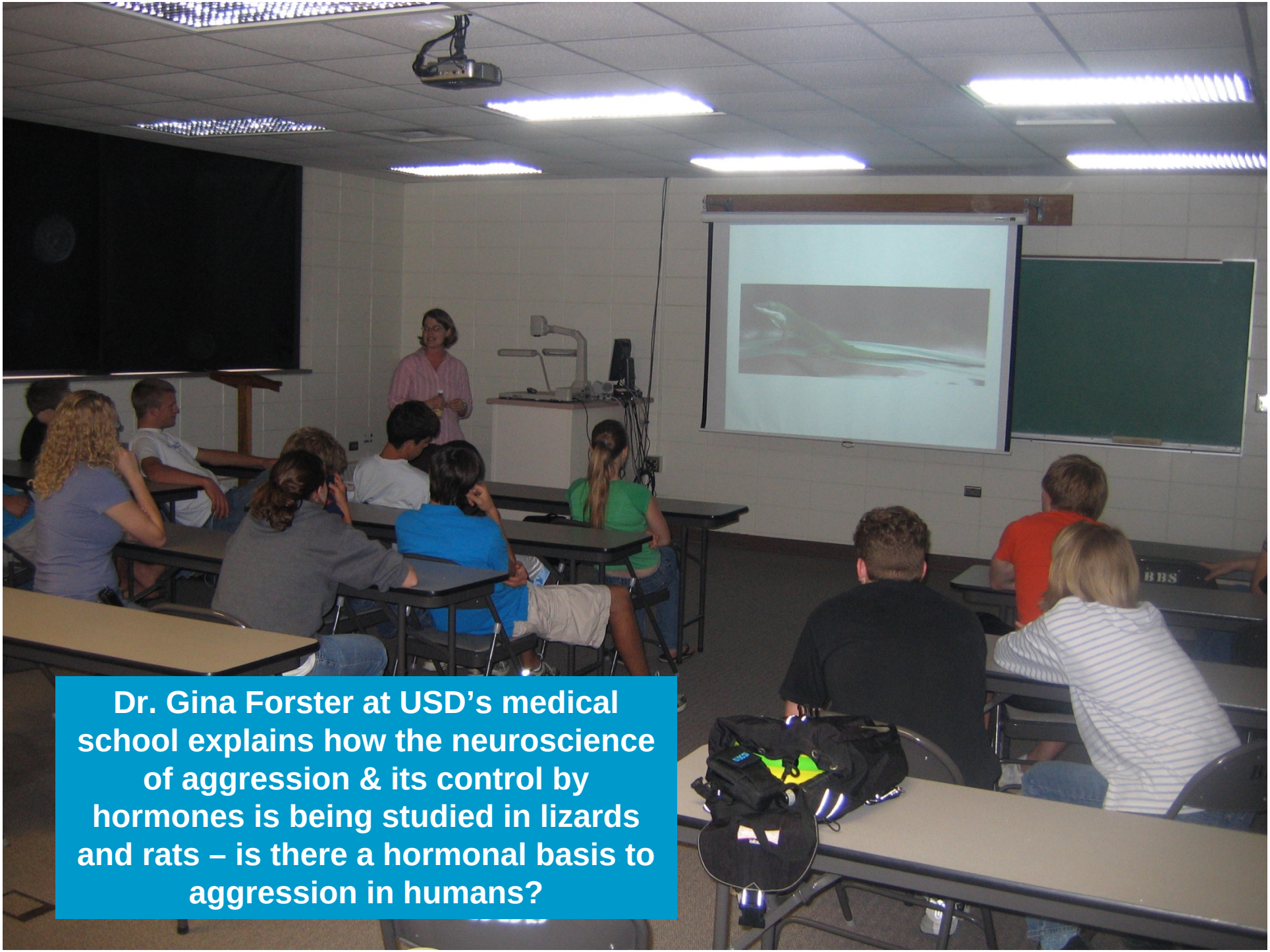

“[NNC] has made me realize how much is out there in the field of science.”
“It really opened my eyes to a career in research that before I had overlooked. I am now considering doing research for a living.”



Part of the Northwestern Neuroscience Camp is a day-long visit to the University of South Dakota's Sanford School of Medicine where we visit 6 or 7active neuroscience research labs. We also visit the CT & MRI scanners at the Orange City Hospital & Clinics.


Here Dr. Alicia Paulson explains her research on the development of the nervous system at USD
In Memory of Viktor Hamburger: 1900-2001
NORMAL STAGES OF CHICK EMBRYONIC DEVELOPMENT

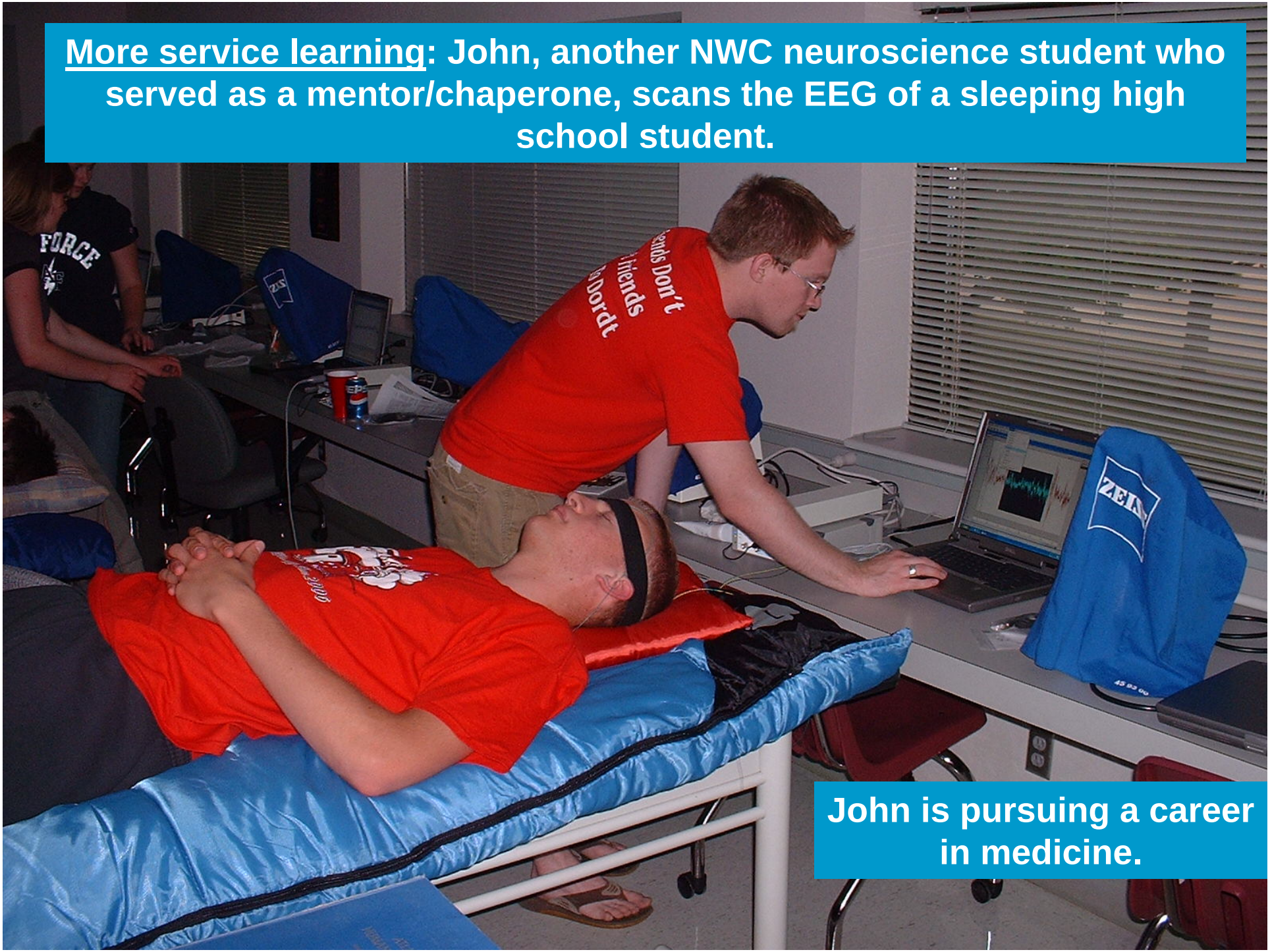

EVOLUTION ONE
So how do neurons know where to grow in the developing nervous system? How is that related to some forms of mental illness?


Dr. Gina Forster at USD's medical school explains how the neuroscience of aggression & its control by hormones is being studied in lizards and rats – is there a hormonal basis to aggression in humans?

Here, one of our NWC NAPs program mentors (Hannah) shows students how to hook up electrodes for EEG (electroencephalography) during our afternoon research session on sleep – brain wave recordings during naps (quite appropriate for our new NAPs program! ☺)

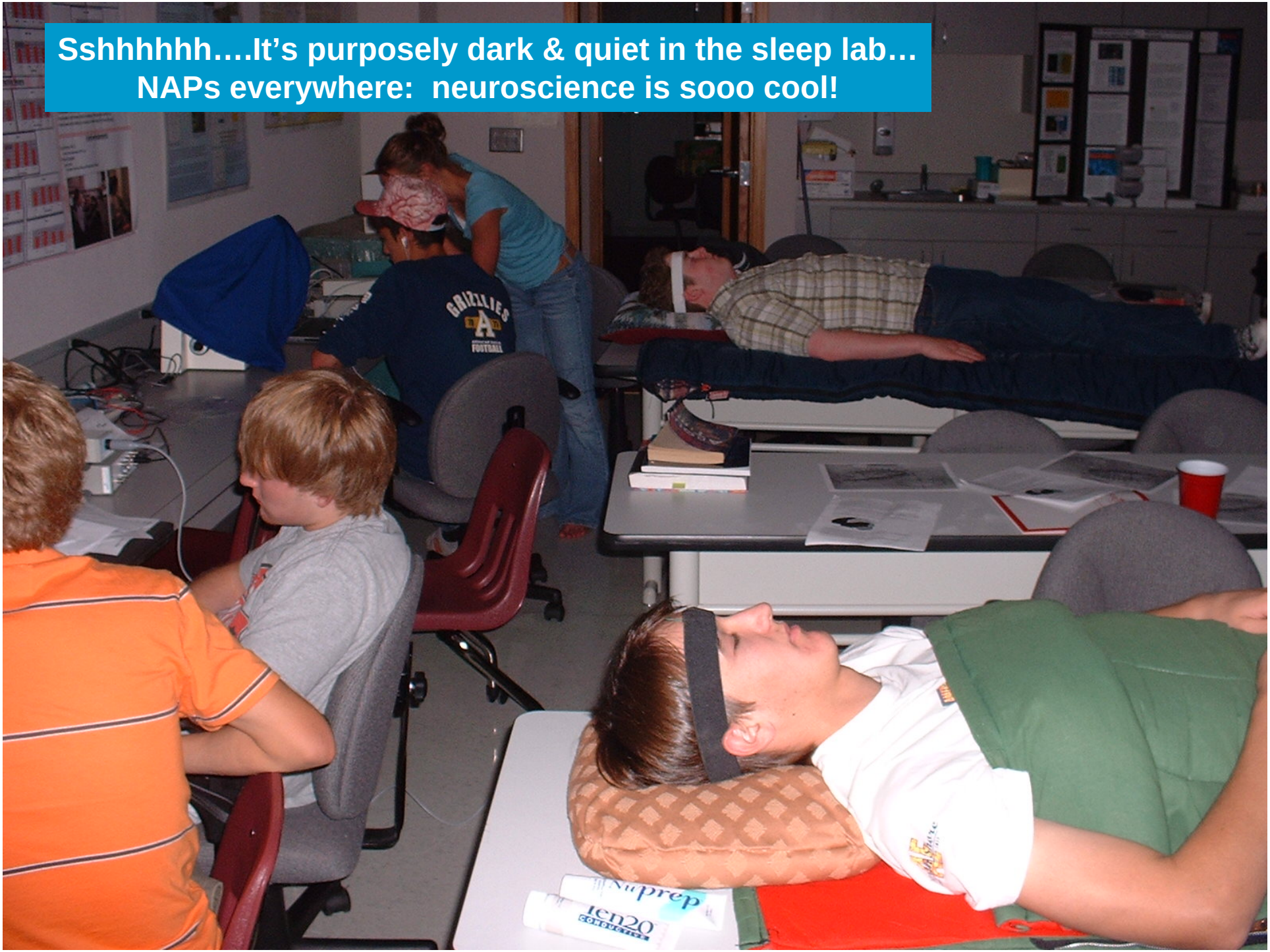
Hannah completed a summer undergraduate research fellowship doing neuroscience research on the neural circuits of learning, addiction, motivation & reward pathways in the brain at the University of Wisconsin – Madison's neuroscience program as well as a summer of research in my neurophysiology & neuropharmacology lab.

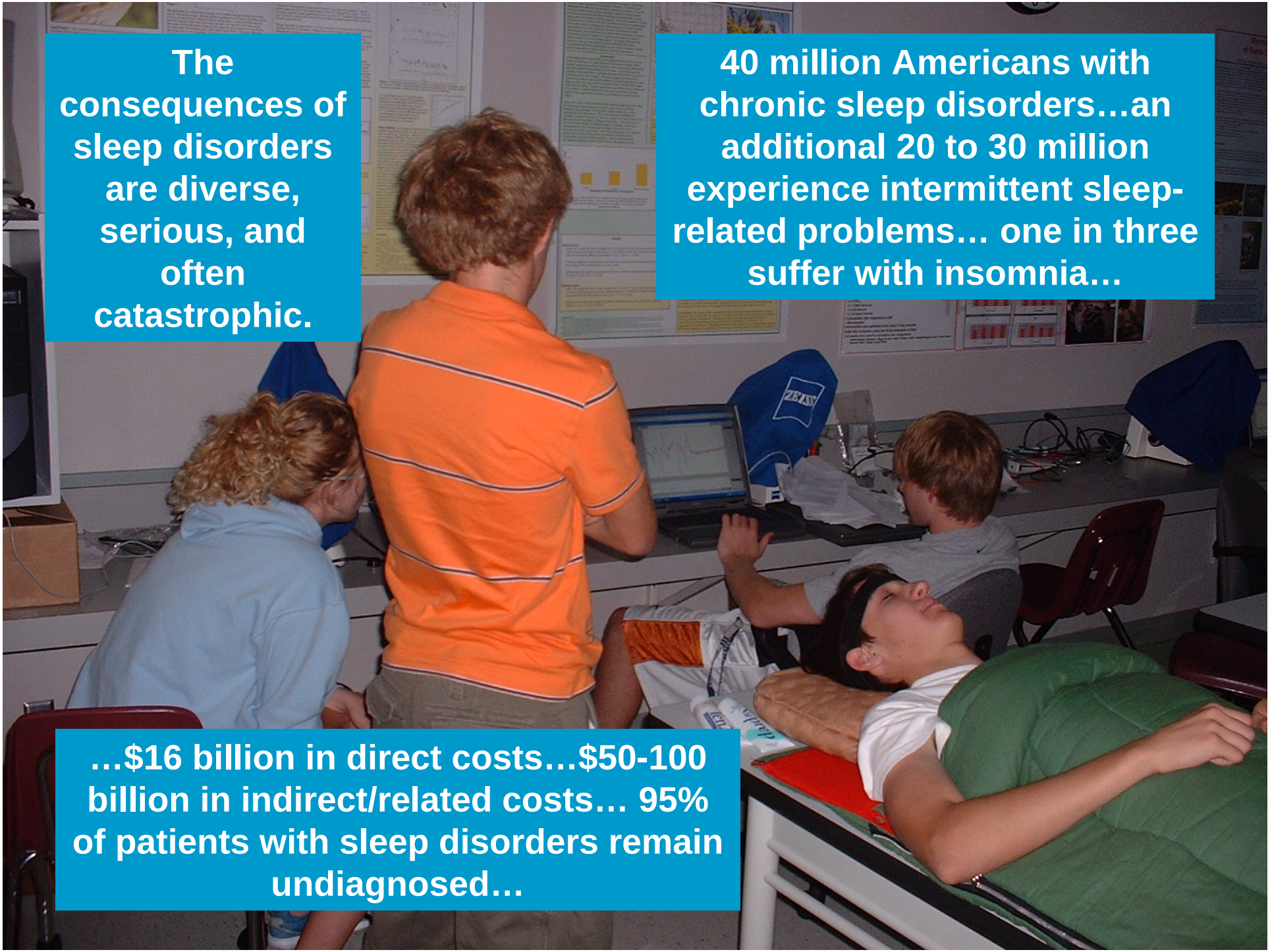
Hannah also worked as a lab assistant helping me to supervise the research of my 3 most recent Honors Research students. She was offered interviews at 4 of the outstanding graduate neuroscience programs in the country & will be starting her doctoral research in neuroscience this fall. (They were very impressed by her diverse experiences.)



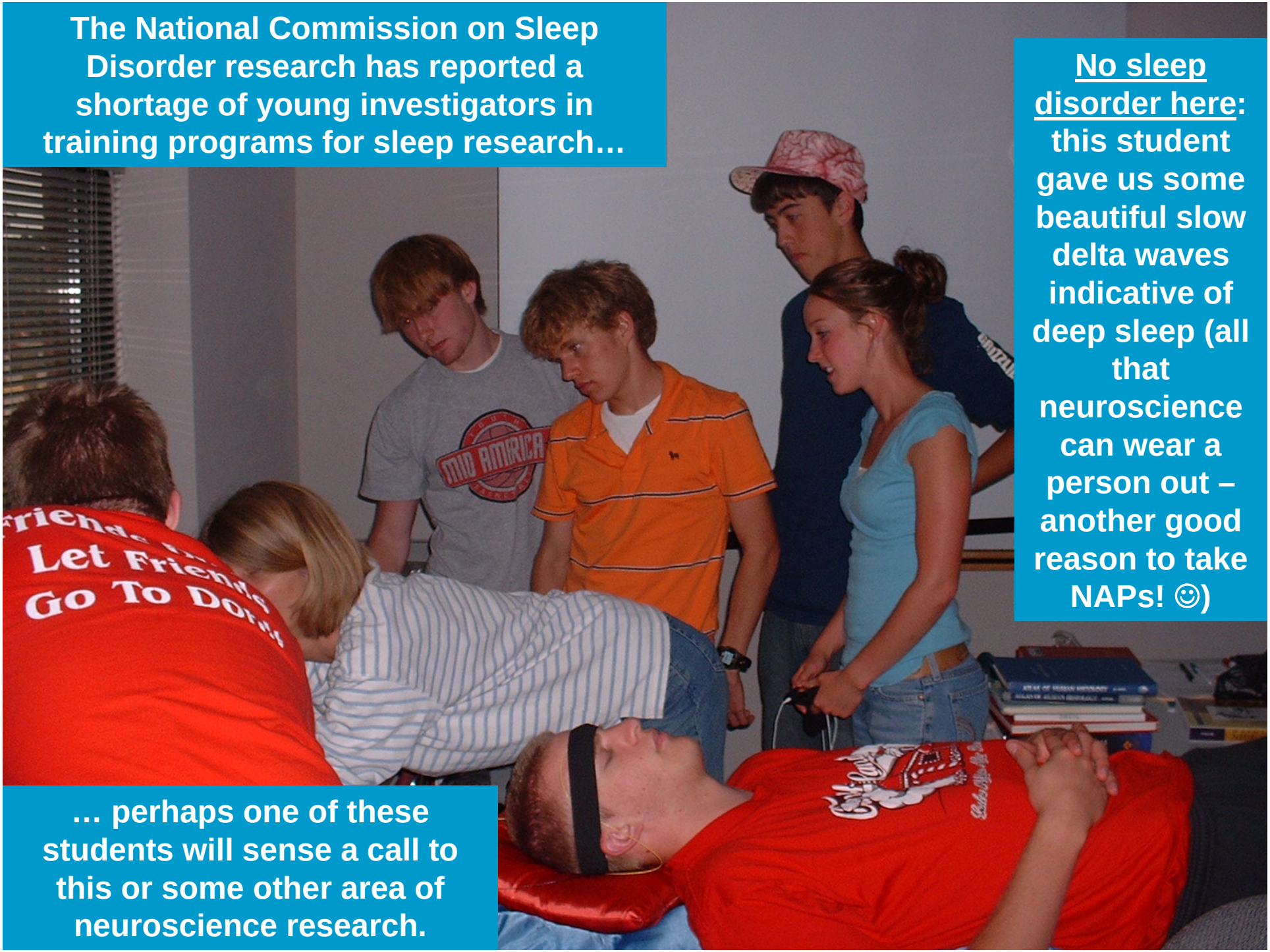
More service learning: John, another NWC neuroscience student who served as a mentor/chaperone, scans the EEG of a sleeping high school student.

John is pursuing a career in medicine.


Sshhhhhh….It's purposely dark & quiet in the sleep lab…
NAPs everywhere: neuroscience is sooo cool!
GRIZZLIES
FOOTBALL
Nuprep
ten20


The consequences of sleep disorders are diverse, serious, and often catastrophic.
40 million Americans with chronic sleep disorders…an additional 20 to 30 million experience intermittent sleep-related problems… one in three suffer with insomnia…
…$16 billion in direct costs…$50-100 billion in indirect/related costs… 95% of patients with sleep disorders remain undiagnosed…

The National Commission on Sleep Disorder research has reported a shortage of young investigators in training programs for sleep research…

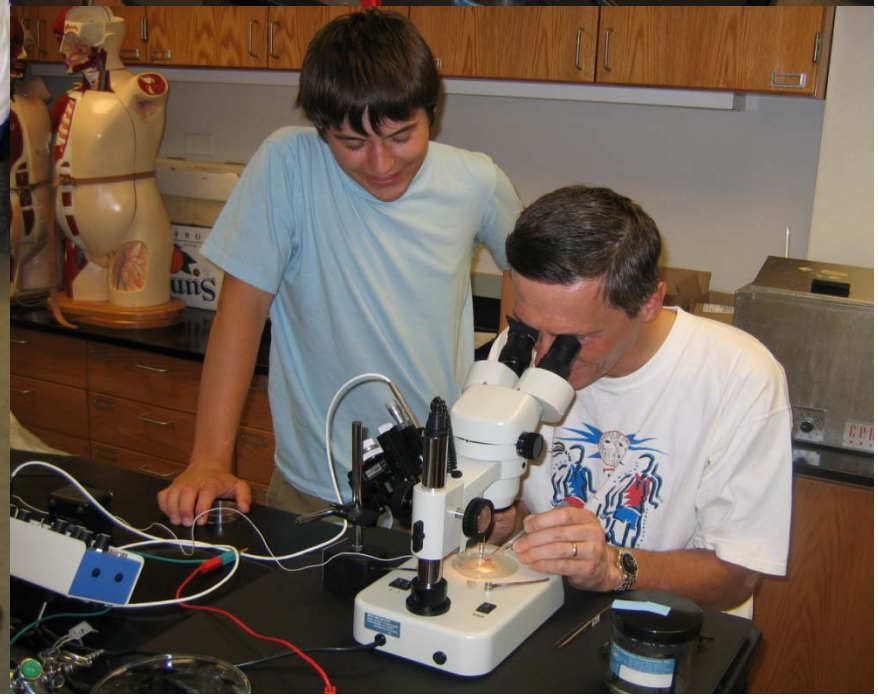


No sleep disorder here: this student gave us some beautiful slow delta waves indicative of deep sleep (all that neuroscience can wear a person out – another good reason to take NAPs! ☺)

… perhaps one of these students will sense a call to this or some other area of neuroscience research.


On the last day of the Northwestern Neuroscience Camp, even the visiting siblings (like little brothers), moms & dads get to learn about & do neuroscience …while we're monitoring his brain, let's monitor his pulse too!

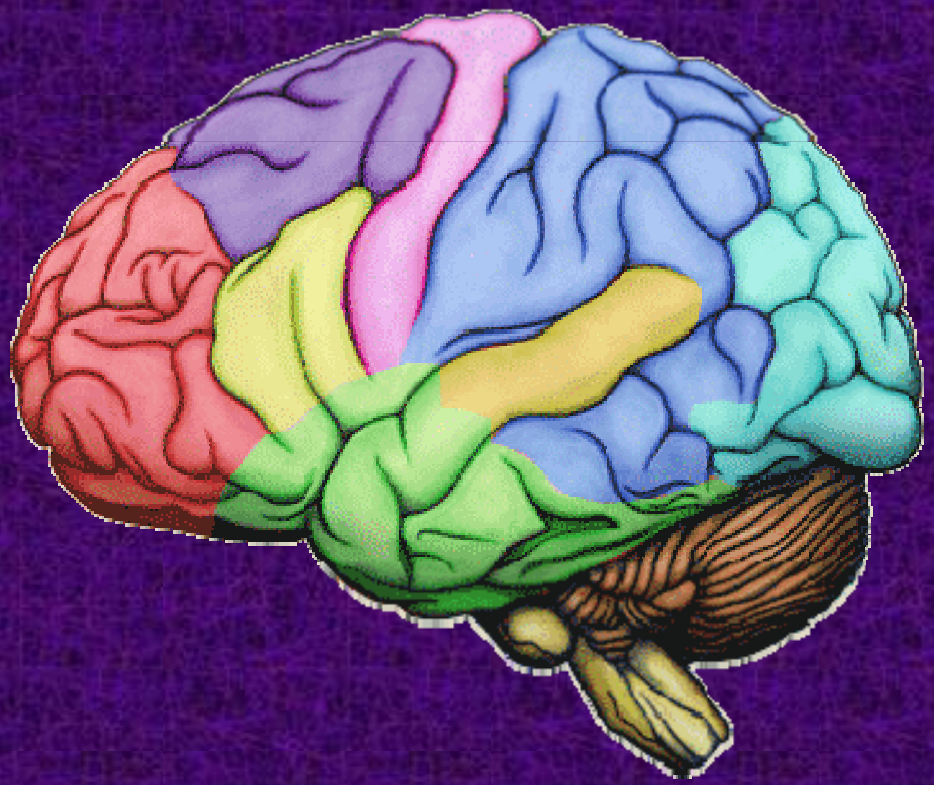
Pay attention, Mom & Dad…sure you can try it too!



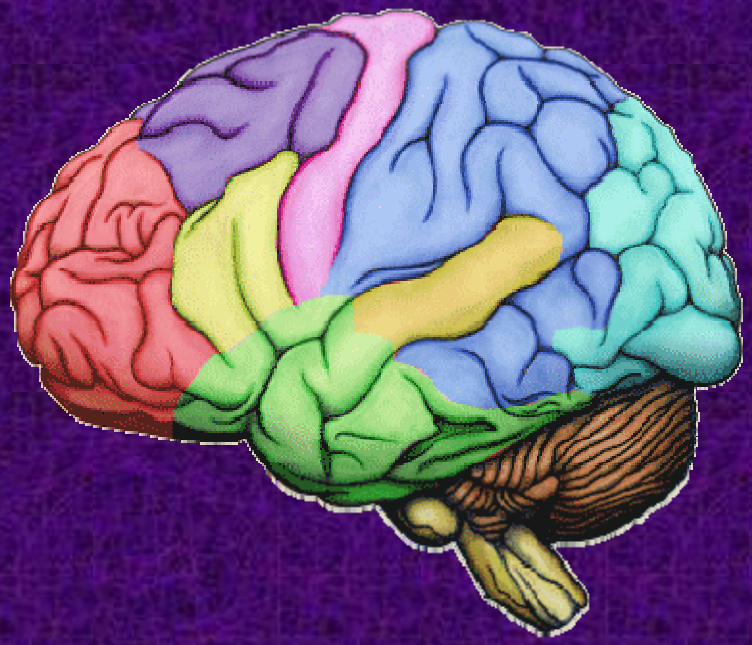
A few comments from camp evaluations:

- “It opened my eyes to a world I didn’t know about – keep offering this opportunity, it is definitely worth it.”
- “It was very enlightening – I had a blast – I wish I could stay for another week!”
- “I learned a lot and had fun at the same time – this camp was fascinating, keep it going.”
- “Camp exceeded my expectations in all areas.”
- “I wish it was several weeks instead of several days. - Thank you very much for all you & your wife & college & staff have done for us.”
- “It is one of a kind.”

Yes, indeed! Neuroscience Across the Continuum!



What is your discipline? Is it possible for you to offer opportunities that begin to build a pipeline of future young scientists in your field? Think outside the box! Think creatively! Think across the age and educational continuum! Use this:



Thanks!
Any Questions?
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