The following handbook contains all relevant information regarding the program, participating school sites, staff introductions and contacts. This guidebook also contains lists of resources and examples from previous outreach efforts.

Student Handbook

2013

A TRUE COLLABORATION.
PSU + WSU-V + OHSU + PNCA
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**Course Site & Content:**
D2L.pdx.edu

Here you will find all the materials for the course, as well as discussion forums, more resources, and course and site updates.

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"Creative strategies are needed to ensure that the United States maintains its competitiveness in the scientific field. Since neuroscience cuts across many different disciplines and can help in understanding all kinds of behavior, it is the ideal vehicle for capturing people’s interest and engaging them in science — at any age." - NIDA Director Nora D. Volkow, M.D.

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**Backyard Brains**

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**Student Handbook**

The following handbook contains all relevant information regarding the program, participating school sites, staff introductions and contacts. This guidebook also contains lists of resources and examples from previous outreach experiences.
The brain is the last and grandest biological frontier, the most complex thing we have yet discovered in our universe. It contains hundreds of billions of cells interlinked through trillions of connections. The brain boggles the mind.” - James D. Watson
Student D2L: Weekly posts are required!***

1. Student Instructors will post daily recaps of class progress including fun stories and what worked and what didn’t.

2. Improve class delivery: Build upon #1 daily to ensure accurate and entertaining delivery by commenting constructively on your co-instructors posts.

3. Finally, complete weekly assigned readings in preparation for the following week.

Expectations

1. Be Involved & Be Present!
   Student instructors are expected to be punctual and engaged each and every class period. Attendance is mandatory and will be collected by site coordinators specific to each site. All instructors must attend school orientation and complete background checks!

2. Maintain Ongoing Involvement Outside of the Classroom***
   Class site to be contributed to by teachers daily including weekly reading posts on D2L.

3. Support Your Co-Instructors
   Additional volunteers/instructors are recruited to help with individual student engagement, management and inquiry. Students are situated in groups and receive additional support and encouragement for topics discussed and application of class projects. When not teaching in front of the class you should be partaking in classroom management.

4. Spotlight on Current Events, News Stories & Relevant Articles
   Making a connection to real-world neuroscience, inspiring scientific interest and motivation . Introduce students to a variety of topics and potential career paths outside of academia, but still relevant to Brain research. Cover topics on Neuroscience and Education in relation to “atypical” developmental issues that often lead to social, and interpersonal problems that go beyond the physical qualities themselves. (I.E. Dyslexia & Astronomy, or Autistic Savants like Temple Grandin).

5. Integrate National Science & Technology Standards
   Through fun activities and lessons students should be encouraged, not required to engage in activities. Classes should implement multiple strategies and activities to complement a diverse class population and promote individual strengths in problem solving as well as connect these students to the global community. http://www.ode.state.or.us/teachlearn/real/standards/sbd.aspx

6. Have Fun and Be Creative!!!
   As an after-school program, our “job” is to foster interest in an under represented subject, promote creative problem solving, support individual & group learning, and provide interactive and engaging activities. We may not be able to cover all material, however the focus is not on the amount of material presented, but how deeply we can connect the concepts to other subjects, personal interests and real-life problems.

“The brain is the organ of destiny. It holds within its humming mechanism secrets that will determine the future of the human race.” - Wilder Penfield
Sabin SUN Program

http://www.pps.k12.or.us/schools/sabin/211.htm
4013 NE 18th Ave, Portland, OR 97212
Phone:(503) 916-6181

Contacts
Kate Gigler - Sabin SUN Program Coordinator
kgigler@pps.net

Rachel Prust - Sabin SUN Program Coordinator
rprust@pps.net

Marc D. Rudolph - TA & Site Program Coordinator
rudolphm@ohsu.edu

Sabin SUN, a program of the Immigrant and Refugee Community Organization (IRCO), aims to improve the lives of children, their families and the community by extending the school day and develop schools as "community centers" in their neighborhoods. SUN Community Schools strive to be a community "hub." They link with other community institutions, such as the libraries, parks and community centers, neighborhood health clinics and area businesses.

SUN Community Schools:
1. Extend the school day and broaden the educational resources for the community
2. Bring and coordinate services to the community
3. Bring the community together to break down isolation and strengthen families.
4. Build relationships across generations, cultures and incomes

Site Visit / Volunteer Orientation
July 2nd & 3rd 10-11am
Jason Lee K-8 SUN Program

http://www.pps.k12.or.us/schools/lee/
Address: 2222 NE 92nd Ave, Portland, OR 97220
Phone:(503) 916-6144

Contacts
Rebecca Wood - Sabin SUN Program Coordinator
p: 719-678-3300

Elias Shaw - Course TA & Site Program Coordinator
eliaspshaw@gmail.com

Also a member of Portland's SUN program, Jason-Lee's summer outreach program allows volunteers to connect in a hands-on manner with the communities of Portland. As a summer instructor, you will have a chance to work with and inspire youth in a very unique setting - inside a class while still outside of the usual classroom experience. The versatility we are able to experiment with allows us to use fun activities and creative lessons to reach out and teach science coursework in a way that many may have never been exposed to before. We hope both the students and instructors walk away having learned something new.
Madison High Gear-Up Program

http://www.pps.k12.or.us/schools/madison/
501 North Dixon Street, Portland, Oregon, 97227-1807 - USA
503-916-2000

Contacts
Katie Lauderdale - SUN CS Site Manager
o. (503) 916-5338  c. (503) 407-8702  e. klauderd@pps.net

Kamran Lehman - Course TA & Site Program Coordinator
kajo.lehman@gmail.com

Madison High School’s Gear up Summer Program is working in tandem with SUN to help incoming freshmen acquire essential reading skills to help them through high school and beyond. We will take our students through a series of fun and challenging neuroscience readings and activities that will give them exposure to scientific literacy and concepts.

What is the GEAR UP program? (Gaining Early Awareness and Readiness for Undergraduate Programs)
GEAR UP is a federal grant that provides funding for college awareness and readiness. The grant is meant to help change a school’s culture so that teachers, students, and families are always looking at higher education as the end result of a student’s schooling. This could be technical college, trade school, community college, or four-year degree programs. Either way, students expect to move beyond their high school graduation, and this expectation is instilled in them at an early age.
# Madison High School: A Focus on Literacy

Below you will see a tentative schedule for Madison.

On the following page is a flowchart for Reading and Literacy skills.

<table>
<thead>
<tr>
<th>MADISON HS SCHEDULE</th>
<th>M</th>
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<tbody>
<tr>
<td>7/22 - 7/25</td>
<td>Curriculum Collaboration w/ Teachers @ Madison HS</td>
<td>Curriculum Collaboration w/ Teachers @ Madison HS</td>
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<td>Teacher Training</td>
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<tr>
<td>7/29 - 8/1 WEEK 1 - INTRO / Neurons &amp; Networks</td>
<td>The Science of Practice</td>
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<tr>
<td>8/5 - 8/8</td>
<td></td>
<td>Reason &amp; Emotion</td>
<td>Emotions Create our Preferences</td>
<td>Military Dog Recovers from PTSD</td>
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<td>WEEK 2 - Reflexes, Emotions &amp; Feelings</td>
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<tr>
<td>8/12 - 8/15</td>
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<td>Phantoms - Ch. 6</td>
<td>Transient Anomia</td>
<td>Emotions Create our Preferences</td>
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<tr>
<td>Week 3 - Attention &amp; Language</td>
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**Behavioral Tip**
What works for one student may not work for another student.

**Fun Fact**
There are over 11 resting state networks in the Brain, and these networks aren’t stationary targets, but constantly shifting maps of neuronal activation.

**Brain Myth**
The amygdala is a single region and is the only nuclei responsible for fear processing.
## Strategies

### Making Connections
Good readers connect what they know with what they’re reading.

- Does this remind me of something?
- Do I know someone like this character?
- Have I ever felt this way?
- What do I already know that will help me understand what I’m reading?

### Predicting
Good readers think about what’s going to happen and make predictions based on what they have read.

- What do I think will happen next?
- Since ______ happened, I think ______ will happen.
- I’m guessing this will be about ______.
- This title/heading/picture makes me think...

### Questioning
Good readers ask themselves questions when they read.

- What is the author saying?
- Why is that happening?
- Is this important?
- This makes me wonder ______.
- How does this information connect with what I have already read?

### Monitoring
Good readers stop to think about what to do when they don’t understand.

- Is this making sense?
- Wait, what’s going on here?
- Should I slow down? Speed up?
- Do I need to reread?
- What does this word mean?

### Summarizing
Good readers identify the most important ideas and restate them in their own words.

- This story is mainly about...
- The author’s most important ideas were...
- What are the key words?

### Visualizing
Good readers picture what is happening while they read.

- What are the pictures/scenes in my mind?
- What do I hear, taste, smell or feel?
- What do the characters, the setting, and the events of the story look like in my mind?
- Can I picture this new information?
The More Prepared, The Better Off You Will Be!

**The “Core” introduction** to the brain classes (Monday and Tuesday of each week) will attempt to convey the following two primary concepts to students...

**Structure determines function**: what something is shaped like determines what it can and will do... What does a neuron do..?

**Neural networks can carry out complex functions**: sensory input - integration - motor/behavioral output. Link several neurons together, and you can get very complex responses to stimuli...

And our neural networks can, and do, change with experience...

1. **MONDAY CLASS (each week)** + Structure determines function

   Neurons are like wires, with one end (dendrites) to receive multiple inputs, a cell body (soma) to integrate all those positive and negative inputs, and another end (the axon) to send out the message to other neurons... Neurons use electricity (charged particles, called ions, that move) to carry information.

2. **TUESDAY CLASS (each week)** + Neural networks

   You have 100 billion neurons in your brain, all wired together at synapses...

   At one end we have neurons, called sensory neurons, that receive information (literally, translate action physical energy into electricity), and at the other end are neurons, called motor neurons, that send electrical messages to move muscles, and generate movement, and behavior...

---

**Build your story!**

These are “suggested” categories for organizing the classroom to simply to ensure consistency. Organize each week so that a foundation for concepts can be built-upon.
Anyone Can Instruct, We Want To Teach!

A. Teacher - Student Interaction
Each student has a different set of character traits, learning styles, emotional and knowledge sets. It is our jobs to facilitate active learning and engagement amongst *every* individual. Our group model is particularly appropriate given the ability for a particular instructor to focus on a very small group of students. As much as time allows, become familiar with your group of students.

Learn their names and use them!
Some students need or prefer more focused attention, others do not.

B. Behavioral Issues & Management
Behavioral issues will arise! Be prepared to deflect conflict or inappropriate behavior in an indirect and positive fashion when necessary.

+ Establish a method for gaining control of the classroom early on.
+ If possible, do not interrupt the entire class. Approach the individual student(s). If you’re leading a class you can ask another instructor to intervene where you see trouble.
+ Give choices, not demands when possible.

C. Content Delivery & Preparation
Be prepared! 4-6th Graders are much more capable than people tend to foresee. Be prepared to:

+ Answer questions that go beyond the scope of the lesson.
+ Offer alternative resources or examples from other content/subject areas (make connections).
+ Learn! You will get much more from the experience if you keep yourself open to suggestion.

See your site specific orientation materials for further information about classroom management expectations and for more tips and tricks!
A TEST OR QUIZ IS NOT THE ONLY WAY TO ASSESS

Challenge your students

As you develop your story or lesson plans, keep in mind all of the different ways you can incorporate STEM based standards as it relates to students’ interests and motivations. Students can take “surveys” rather than quizzes or tests. We can still collect good data by including different kinds of questions, labeling activities and so on. Give your students opportunities to be creative and think outside the box - maybe start or end with a fun question or drawing exercise. For example, you could ask the student to draw what they know about, or how they think about the brain to get things rolling - for example:

**Week 1 Survey**
Students indicate interests, reveal what they may or may not know about the Brain and Nervous System, and create a question for Neuroscience. Indicate initial interest in creating a video project, taking tour, etc. and maybe draw something funny about the brain and/or behavior.

**Week 4 Survey**
Students reflect on course content, speculate on how Neuroscience can inform and improve [their] education, indicate their favorite topics and and so on. Information gathered can be used to further develop the course as well as serve to satisfy the quantifiable aspect of standards and help fund the program.

See handout on D2L: How to Read the Next Generation Science Standards (NGSS)
STUDENTS TOUR HUMAN & PRIMATE NEUROSCIENCE LABS

Connecting Research and the Community:

Visiting Scholars and Neuroscience Students from OHSU will present material as well as conduct tours of their labs to introduce their work and further help to connect the community to ongoing research.

Class Field Trips to OHSU:

1. Visit the Neuroimaging & ADHD labs @ OHSU and introduction to the YES! Outreach Program.

2. Touring the Primate Center OHSU campus in Beaverton and participating in a classroom experience.

*Parental approval required. Example forms toward the back of the handbook.

“A knowledge of brain science will provide one of the major foundations of the new age to come. That knowledge will spawn cures for disease, new machines based on brain function, further insights into our nature & how we know” — Gerald M. Edelman
Current Events
Neuroscience in the news

+ Girl With A Rare Form Of Epilepsy Had Half Her Brain Removed

+ Military Dogs and PTSD

+ Dog fMRI: What Is Your Dog thinking?

+ Humanoid Robot Helps Train Child with Autism

+ Neuroimaging, Genetics, and epigenetics

+ Others???
Project-Based Learning

The Neuroscience Outreach Program gives students from underserved communities a chance to thrive beyond the standard academic environment, and incorporate an educational model that embraces the role of the arts in science education.

Exposure to, and interest in the neurosciences will continue to gain momentum as wonderful interactive technologies surface and begin to reach the community. Such technologies will serve to educate, and with equal importance, engage and inspire students to explore complex topics.

Our outreach efforts take these endeavors further by integrating such technologies within our dynamic classroom environment. Students are then afforded the opportunity to apply concepts learned and develop their own novel learning and instructional techniques for topics of most interest. Our model guides the student through an enriched multi-sensory experience to foster creative problem-designing as well as problem-solving.

Give students a chance to share their knowledge and showcase their talents!
Activities: Structure

Be Creative...

1. **Drawing a neuron** (with help from artist Jeff Leake): Think about the different parts of a neuron and what they do (dendrites, receive information; cell body, integrates information; axon, outputs information...)

2. **Imaging techniques**: Lots of pictures, from electron microscope images to structural MRI. Let’s examine structures. Plastic brains, NIDA posters, etc...

3. **Mindflex game**: Neurons use electricity to send messages, which means your brain generates electricity (enough to power a 60 watt bulb!). And some of this electricity can be detected at the scalp...

4. Others?

Activities: Neural Networks

Don’t just talk about connections...make them.

1. **Neuro-Ringtoss**: It’s the excitatory vs inhibitory team

2. **Spikerbox**
   http://backyardbrains.com/experiments/

3. **SnapCircuits** Game or Play dough electricity circuits & networks

4. Others?

Activities: Cell Biology

Connect learning to school-based curriculums

1. **Cell Membranes and Milk**: http://youtu.be/mc5ljuG4FYE?t=3m21s

2. What else?

---

See D2L for more resources and ideas!

Also, visit SabinBrains.wordpress.com for more...

Inspiration & Multimedia Learning Resources: SFN Video Archives:
https://docs.google.com/document/d/1Oru0tMrDPkOLxWpj4Wp_u7g2NsZvYFShw-WeJ_cFS7s/edit?usp=sharing

NEXT UP >
SOME EXAMPLE LESSON PLANNING TEMPLATES & GUIDES
Neuroscience Lesson Planning Template

A. Lesson Objective / Abstract

MAIN TOPIC: Emotions

Help students gain an understanding of how the brain processes emotions through the use of stories, readings and a simple scientific experiment.

B. Materials / Resources

- Brain model and/or Images of brain
- YouTube video: http://www.youtube.com/watch?v=xNY0AAUUtH3g
- Brainflex: simple science experiment to see if emotions alter performance

C. Topic Introduction / Key Vocabulary

Introduce students to brain structures responsible for processing emotions, and how these structures work together.

Key Vocab:
Amygdala, PTSD, neurotransmitters, adrenaline, cortisol, dopamine, oxytocin, serotonin, hypothesis etc.

D. Main Activity

Individual reading/writing: students work to annotate reading, highlight key vocabulary, answer questions and respond to reading by relating it to their lives.

Mindflex experiment: student volunteers compete against each other on the mindflex. In one round, students will compete with an additional variable of emotional salient stimuli. Teach students the concept of a control group. The class acts as scientists, observing and recording the data. Have them form a hypothesis by asking them what they expect to happen. A group discussion will follow about the class’ observations and insights.

E. Evaluation & Assessment

Review topic with students and assess the following:
I. How well were students engaged in the mindflex experiment?
II. What insights did the class have from their observations?
III. Did they comprehend the readings?
# Neuroscience Lesson Planning Template

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<th>Lesson Objective / Abstract</th>
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<th>Materials / Resources</th>
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<table>
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<tr>
<th>Topic Introduction / Key Vocabulary</th>
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<tr>
<td>Activity / Demo</td>
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<th>Evaluation &amp; Assessment</th>
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<tr>
<th>Additional Classroom Considerations</th>
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<tr>
<td>(e.g. seating configuration, volunteer support, etc.)</td>
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Mindflex Activity Guide Example

Objectives: The Scientific Method

A. Understand how physiological signals can be translated into an electrical signal.
B. Identify how these signals can be measured and recorded.
C. Explore strategies for both increasing and compromising performance.
D. Record & Discuss Results

Team Name ________________________________

Member #1 ________________________________ Played Before Yes No

Member #2 ________________________________ Played Before Yes No

Explore: For Students As a Group

General discussion
What physiological signals are measured and how do they control ball movement? How might the headband work? What other physiological signals could be measured that may or may not interfere?

Experimental Design: Generate hypotheses (make predictions!) about how this works.
How can we measure or test how the Mindflex works? What results do you expect? How are you going to do xyz? “If you do abc, will that really measure what you want?”

Discuss Results
Interact with the Mindflex to flush out experimental designs. Use the “freestyle” game mode and only attempt two strategies each due to time constraints. What works, what doesn’t for each team member?
Lesson Summary: This lesson allows students to apply engineering principles in the science classroom. Students learn how neurons convey information through designing and building a physical model of neurotransmission.

Standards Alignment - Minnesota Science Standards

- Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems. 
  Benchmark codes: 9.1.2.1.1
- Engineering design is an analytical and creative process of devising a solution to meet a need or solve a specific problem. 
  Benchmark codes: 9.1.2.2.1 & 9.1.2.2.2
- Natural and designed systems are made up of components that act within a system and interact with other systems. 
  Benchmark codes: 9.1.3.1.1 & 9.1.3.1.2
- Science and engineering operate in the context of society and both influence and are influenced by this context. 
  Benchmark codes: 9.1.3.3.1 & 9.1.3.3.2
- Organisms use the interaction of cellular processes as well as tissues and organ systems to maintain homeostasis. 
  Benchmark codes: 9.4.1.1.1 & 9.4.1.1.2
- Cells and cell structures have specific functions that allow an organism to grow, survive, and reproduce. 
  Benchmark codes: 9.4.1.2.2, 9.4.1.2.4, & 9.4.1.2.5

Objectives—Students will be able to

- identify the parts of the neuron and describe their function(s)
- understand the synaptic transmission
- design and build a model to explain how neurotransmitters move from presynaptic neuron to postsynaptic neuron

Assessment Options

- have students present their physical models to the class
- evaluate student reports
- evaluate students’ concept maps on neurotransmission

Teacher Notes

- This activity works best as a follow up to bead neuron or connect the neuron activity.

Materials

- Marbles and/or bead of different sizes
- Plastic containers
- Plastic bottles
- Scissors
- Tape
- Rubber band
- String

© 2000-2011, BrainU, University of Minnesota Department of Neuroscience and Department of Curriculum and Instruction. SEPA (Science Education Partnership Award) supported by the National Center for Research Resources, a part of the National Institutes of Health, with additional funding from SEDAPA and ARRA.
SUN COMMUNITY SCHOOL  
Field Trip  
PERMISSION SLIP  

• **Event:** The Brains class will be going to Oregon Health Sciences University for a tour of the neuroscience labs.

• **Date/Time:** TBD

• **Transportation:** Students will have options of riding in the private cars of the SUN Site Manager, or having parent/guardians provide transportation and also come along for the tour. Students will leave Sabin School at 9:00am and return to the school by 11:30am.

• **Contact:** QUESTIONS?  
Kate Gigler, 503-916-6707 (office) OR 503-360-3104 (cell)  
Marc Rudolph: 503-896-6063

(Please keep above info for your reference)

(Please return slip below to Kate)

**Student Information**
Name

**Parent/Guardian Emergency Contact Information**
Parent/Guardian Name(s):
Phone:

I hereby agree that my child may participate in Sabin SUN School activity listed above, and release and waive IRCO, its employees, agents and representatives, officers, as well as directors, and partner agencies, from any and all liability for any loss or injury sustained or incurred (including any loss of injury resulting from the representatives, offers, and/or directors) while my child participates in Sabin SUN School activities. By signing this permission slip, I have read and understand the consent and waiver statement above.

Parent/Guardian Signature    Date

Date Here - OHSU tour field trip
Advanced Imaging Research Center
MRI Subject Screening Questionnaire

Subject Name: ___________________________ Date: ________________
Sex: ______ Age: ______ Weight ______ Subject Number: ______ IRB#: ________________

This questionnaire is designed to assist us in determining if it is safe for you to undergo a magnetic resonance imaging procedure. It is important that you answer all of the following questions. **If you don’t understand any question, please ask for assistance.**

1. Do you have a pacemaker, wires, defibrillator, or implanted heart valves? Yes ☐ No ☐ Don’t Know ☐
2. Have you ever had any head surgery requiring aneurysm clips? Yes ☐ No ☐ Don’t Know ☐
3. Have you ever had any type of surgery? Yes ☐ No ☐ Don’t Know ☐
4. Have you ever had a reaction to a contrast agent used for MRI, CT or X-ray? Yes ☐ No ☐ Don’t Know ☐
5. Do you have any surgically implanted metal of any type in your body? Yes ☐ No ☐ Don’t Know ☐
6. Have you ever been exposed to metal fragments that could be lodged in your eyes or body? Yes ☐ No ☐ Don’t Know ☐
7. Do you have a hearing aid, middle/inner ear prosthesis or dentures? Yes ☐ No ☐ Don’t Know ☐
8. Do you have any metal pin, joint, prosthesis or metallic objects in, or attached to, your body? Yes ☐ No ☐ Don’t Know ☐
9. Do you have any type of electric device (stimulator or pump) implanted in your body? Yes ☐ No ☐ Don’t Know ☐
10. Do you have or have you ever had tattoos, tattooed eyeliner, lip liner, or body piercing? Yes ☐ No ☐ Don’t Know ☐
11. Do you wear a transdermal patch (nitroglycerin or nicotine)? Yes ☐ No ☐ Don’t Know ☐
12. Do you have a history of panic attacks or a fear of enclosed or narrow places? Yes ☐ No ☐ Don’t Know ☐
13. Do you have a history of drug or food allergies? Yes ☐ No ☐ Don’t Know ☐
14. Do you have a history of renal disease, seizure, asthma, or emphysema? Yes ☐ No ☐ Don’t Know ☐
15. If you are a woman- are you pregnant, or is it possible that you might be pregnant? Yes ☐ No ☐ Don’t Know ☐
16. If you are a woman- are you breastfeeding? Yes ☐ No ☐ Don’t Know ☐
17. Is there any other item or device you believe we should know about prior to performing the procedure- if yes, please describe:

_________________________________________________________________________________________________________

I certify that I have read and understood the questions asked in this questionnaire and that the above responses are correct to the best of my knowledge. I understand that it is my responsibility to inform OHSU staff of any metal fragments and/or devices that may be in my body and that by failing to do so may cause serious bodily injury or be life threatening.

__________________________________  __________________________________________  ______________
Patient or Legal Representative Signature  Print Name and Authority (if legal representative)  Date

Witness or Interpreter Signature  Print Name  Date

I have reviewed the MRI screen form with the subject and have determined that it is safe for him/her to proceed with the MR study as outlined in the consent.

__________________________________  __________________________________________  ______________
Principal Investigator/Physician/Registered Nurse  Print Name and Title  Date
The Scientific Method

http://www.biologycorner.com/worksheets/controls.html

The scientific method is the best way yet discovered for winnowing the truth from lies and delusion. The simple version looks something like this:

1. Observe some aspect of the universe.
2. Invent a tentative description, called a hypothesis, that is consistent with what you have observed.
3. Use the hypothesis to make predictions.
4. Test those predictions by experiments or further observations and modify the hypothesis in the light of your results.
5. Repeat steps 3 and 4 until there are no discrepancies between theory and experiment and/or observation.

When consistency is obtained, the hypothesis becomes a theory and provides a coherent set of propositions, which explain a class of phenomena. A theory is then a framework within which observations are explained and predictions are made.

1. Identify the problem
2. Collect information about the problem
3. Propose a hypothesis
4. Test the hypothesis by conducting experiments, making comparative observations, and collecting data
5. Evaluate the data collected through investigation
6. Draw conclusions based on data and determine whether to accept or reject the hypothesis
7. Communicate results and ask new questions
*8. Record initial results