Welcome -- from the Curators

Professionals are magicians. It’s true even in engineering - all those formulas, integrals, derivations; it all takes a tremendous amount of dedication and cognition to piece together. With enough time and attention, you start to notice methods to the magic. You learn. But learning alone was never enough. Once you learn the methods, it’s time to start practicing. You do. But doing alone was never enough. With enough discipline and dedication to professional practice, others will learn from your performance. You teach. The goal of this document is to expedite your mastery of professional practice with the HYPER Community through this learning–doing–teaching progression.

The HYPER Community will be a place for learning things that are unlike anything you’ll learn in a classroom. We started this document so you won’t have to decipher the HYPER Community, or the lessons we’ve already learned that are no longer worth relearning.

This document covers three phases of professional practice in the HYPER Community:

1. **Onboarding.** This includes everything you need to know post-interview, such as the Community culture, how to get started, and the general organization of both the Laboratory space and time.
2. **Training.** Every Community has evolved key systems that sustain performance. You will be able to quickly contribute to nearly all projects in the lab through mastery of these trainings.
3. **Transcending.** There is much to learn from those before us. In this section, we bridge the gap to professional practice by sharing stories of alumni who are now professionals. Sometimes there is need for encouragement.

Wishing you lots of mind-blowing engineering and scientific discoveries as your future colleagues,

*Hannah Gardner, Ian Wells, and Chase Phillips, The Curators, 2020*
Learn one.
Do one.
Teach one.

~Hannah Gardner
Ron Bliesner came to WSU in 2008 because he wanted to go to a college that had a good basketball team. Curious and questioning, he followed his passion for electrical circuits and heat transfer to my office door with an inquiry about undergraduate research. Soon thereafter, Ron built the Cryocatalysis Hydrogen Experiment Facility (CHEF) using parts from the local hardware store. He was the first to graduate from the lab in 2013, with a Master of Science in Mechanical Engineering. Now he’s a lead engineer at Blue Origin on the type of project that comes along only once in a Blue Moon...

Christopher Chaney, Patrick Adam, Justin Bahrami, Eli Shoemake, Alex Mattson, and Patrick Adam were a ragtag bunch between the AIAA club, courses I taught, and graduate school. Their goals coalesced with the mission to build Genii – the first liquid hydrogen fueled drone designed and built by a university team, on an entirely too small $20k budget. Their concept is now the future of drone reconnaissance for the US Army.

Ian Richardson called me before I’d even arrived at WSU in 2010 asking to begin undergraduate research. When he graduated with a Ph.D. in 2017 he had amassed over $500,000 in externally funded projects initiated from his internships at NASA. Now he’s the CEO of a WSU startup company, Protium, which focuses on liquid hydrogen technologies.

...and the most amazing -- world changing -- stories are likely being written right now.

The HYPER Community mission is to efficiently advance the Technology Readiness Levels of cryogenic and/or hydrogen systems for the betterment of humanity. But make no mistake about it – the HYPER Community exists for, and we most efficiently achieve this mission by, producing professionals who further the practice.

This document, like our community of professionals, is living and continuously changing. When you see opportunities for improvement to our community (including this document), act on them. Don’t grade it. Fix it.

Becoming a professional is the reason you are here, and it will be one of the hardest things you will ever do.

*Jacob Leachman, 2/2020*
Don’t grade it. Fix it. ~Richard T Jacobsen
Fix it so that it never happens again. ~Jake

Becoming a Professional is the reason you are here,

& it will be one of the hardest things you will ever do. ~Jake
ONBOARDING

THE INTERVIEW

Congratulations on surviving! What just happened? The interview is determining the following:

<table>
<thead>
<tr>
<th>Question</th>
<th>Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>How did you end up here?</td>
<td>More general than the traditional “Tell me about yourself” and an invitation for you to show us something about yourself.</td>
</tr>
<tr>
<td>Why [insert Major here]?</td>
<td>What evidence do you have that this is the best title to define your career training?</td>
</tr>
<tr>
<td>What’s your blue sky?</td>
<td>What is your passion? Does this align with current Community needs?</td>
</tr>
<tr>
<td>What’s your role on a team?</td>
<td>We look for five main personality sets:</td>
</tr>
<tr>
<td></td>
<td>1. Driven leader/liaisons</td>
</tr>
<tr>
<td></td>
<td>2. Efficient Theoreticians</td>
</tr>
<tr>
<td></td>
<td>3. Utilitarian mechanics</td>
</tr>
<tr>
<td></td>
<td>4. Experienced sages</td>
</tr>
<tr>
<td></td>
<td>5. Empathetic communicators</td>
</tr>
<tr>
<td>When can you work?</td>
<td>Can you be in the same place, at the same time, with the rest of your team?</td>
</tr>
</tbody>
</table>

In the spirit of continuous improvement, we necessitate that you improve our community through your performances as you become a professional. The goal is for everyone to transcend the HYPER community with at least three freakishly awesome professional achievements unique to them, functioning as evidence of professional performance. It won’t be easy. That’s why we start people early - the next several years are the truest form of interview.

WHY HYPER? WHY HERE? WHY NOW?

Washington State is the leading aerospace state in the US and the state with the highest percentage of clean energy. Hydrogen is the fuel of the future for both sectors. Jake knew this because he grew up in the Pacific Northwest. The name Hydrogen Properties for Energy Research (HYPER) stems from Jake’s experience writing the leading equations of state establishing the thermophysical properties of hydrogen.

But why WSU? If you don’t know what it means to be a ‘Land Grant’ Institution, then you don’t know why you’re here. Not only does our Land Grant heritage shape WSU’s past, it will shape our future. The HYPER laboratory’s mission is derived from and defined by our Land Grant heritage. Check the https://hydrogen.wsu.edu weblog and search for writings on Land-Grant for more information.

The HYPER laboratory is the only cryogenic hydrogen research laboratory in academia in the US. Space is a cryogenic vacuum; 74% of which is hydrogen by mass. Humanity’s continued evolution necessitates mastering cryogenic hydrogen.
We chose the name ‘Genii’ from the Latin Pondus Hydrogenii (a.k.a. ph), the Power of Hydrogen.

~Justin Bahrami
COMMUNITY STRUCTURE

Although Professor Leachman is the Community Director and authority of the laboratory, he prefers you to call him simply by Jake as he is a contributing professional of the community; like everyone else. Although it is important to acknowledge and respect titles like ‘Dr.’, you should always base your decisions and personal safety on the merit of what is being said in the moment. Listen politely to everyone. Do what you think is best.

The HYPER Community has many paying clients from many different sectors requiring a team of staff members to enable the HYPER community to function. Mark Parsons is the first member of the staff team and is the HYPER community manager in charge of finances, purchasing, and personnel. Mark joined the HYPER community in 2019.

The Post-Doctoral Faculty and Graduate Students are defined as Community Members and, typically, serve as Team Leaders. Each team leader is responsible for delivering outcomes on the funded project goals, objectives, and tasks that honor the commitments we made to receive the funds. They are also responsible for completing their theses, dissertations, and publications that serve as the evidence required to advance their professional careers. Each team has 3-6 supporting individuals that complete the key team-roles described in the interview.

The Core Team is the exception to this structure. This team solves the problems generally faced by all of the other teams within the community, like this document. This team reports directly to Jake and Mark.

OUR PRIORITIES

1. Foster a community of professional practice.
2. Tenacious improvement of our repetitive use systems.
3. Freakishly awesome engineering achievements.
4. Advancing the technology readiness level of cryogenic and/or hydrogen systems for the betterment of humanity.

FIRST STEPS

Before you start work, there are a few things you must do. Now that we have established authority and intent, we need to tell you the ground rules and expectations for our community above and beyond those of WSU. The MOU and Performance Spec are the documents that outline this framework. Your tasks are to:

1. See the Community Manager, Mark Parsons.
   a. Memorandum Of Understanding (MOU), included later in this section
   b. Work Specification, included later in this section
   c. Get a temporary employment form (Mark)
   d. Be added to MS Teams (Mark)
2. Fill out the W9 and set up payment
3. Begin Trainings
Listen politely. Do what you think is best.
~Jâke
MEMORANDUM OF UNDERSTANDING (MOU)

The Hydrogen Properties for Energy Research (HYPER) community at Washington State University (WSU), founded in August of 2010, continues the mission to advance the technology readiness level of cryogenic and/or hydrogen systems for the betterment of humanity. To fulfill this mission, members of the community must endeavor to continuously improve the professionalism of both themselves and the lab community. This Memorandum Of Understanding (MOU), drafted in August of 2018, defines and establishes mutual commitments of the Laboratory Director and Laboratory Members to promote professionalism – the pursuit of personal responsibility, self-confidence, high intellectual standards, quality of work, experienced judgement and discretion, and service to society and profession.

Expectations of the Community Director

The Community Director is defined as the person responsible for all HYPER laboratory professional decisions, including matters regarding final approval of research products, financial commitments, legal commitments, and personnel affiliations with the laboratory.

1. The Community Director shall continuously improve their own professionalism and the professionalism of the laboratory.
2. The Community Director shall at all times advise lab members in their professional best interest, in accords with this MOU, and make every effort to provide opportunities for the continued professional development of lab members.
3. The Community Director shall take full responsibility for the quality and accuracy of laboratory research products, e.g. papers, reports, presentations, and official external laboratory communications through the website or the media.
4. The Community Director shall make every effort to secure financial support for the laboratory and lab members.
5. The Community Director shall take full responsibility for laboratory fiscal commitments.
6. The Community Director shall make every effort to continuously improve the safety of the laboratory.
7. The Community Director shall serve as an impartial mediator in conflicts between Community Members and should a conflict arise between the Community Director and Community Member(s) find an impartial mediator.
8. The Community Director shall guide the long-term mission of the laboratory to ensure continued relevancy to our societal constituencies.

Jacob Leachman, Ph.D. August 2018
Expectations of the Community Members

A HYPER Community Member is defined as an individual who develops their professionalism by contributing to the HYPER community and research products that advance the laboratory Mission over a multi-year period.

1. *The Community Members shall* use the laboratory community to continuously improve their own professionalism as defined in this document and by the ethical standards established by the profession they plan to enter (e.g. CSA, ASME, ASM, AIChe, IEEE, ASEE, ASCE, etc).

2. *The Community Members shall* serve as representatives of the HYPER laboratory to our societal constituents.

3. *The Community Members shall* make every effort to maximize the quality, dissemination, and accuracy of laboratory research products, e.g. papers, reports, presentations, and external laboratory communications through the website or the media.

4. *The Community Members shall* make every effort to participate punctually in laboratory community events, including regular laboratory meetings and presentation/dissemination of research products by lab members.

5. *The Community Members shall* take full responsibility for their personal safety, recognize that any safety incident reflects poorly on the lab community, and endeavor to continuously improve the safety of the laboratory for all lab members.

6. *The Community Members shall* continuously improve the laboratory spaces (e.g. physical, financial, and virtual) to fulfill the lab Mission and the expectations of this document.

7. *The Community Members shall* develop a mutually agreed upon project specification with the Laboratory Director and be objective and efficient with the progress and completion of their assignments and/or projects.

8. *The Community Members shall* communicate all issues that jeopardize the expectations set forth in this document promptly to the Laboratory Director.

9. *The Community Members shall* communicate their planned transition to Laboratory Alumni with the Laboratory Director at least three months in advance of their transition.

10. *The Community Members shall* read and understand the HYPER ABSTRACT in its entirety.

Name
Signature
Date
Expectations of Part-time Community Members

A HYPER Community Part-time Member is defined as an individual who contributes to the HYPER community and research products that advance the community Mission over a short or temporary time period, usually 1 semester.

1. *The Community Part-time Members will* be given access to HYPER Community communication systems (MS Teams) and computing systems that are for professional development purposes only. Access to these systems will end at project completion. Community part-time members are expected to monitor MS Teams channels and reply within a day to direct messages and inquiries.

2. *The Community Part-time Members will* be placed on time-slip appointment when possible. It is your responsibility to log your time and submit your time cards for approval by the Community Director or Manager.

3. *The Community Part-time Members shall* be given a project and a HYPER laboratory member to report to for their project activities.

4. *The Community Part-time Members shall* develop a project specification document to define the goals and objectives of their activities and the anticipated outcome/products or result of the effort in order to stay focused on project deliverables. This project specification will be mutually agreed upon and signed for approval by the Community Director and the relevant HYPER Community Member.

5. *The Community Part-time Members shall* take full responsibility for their personal safety, recognize that any safety incident reflects poorly on the lab community, and endeavor to continuously improve the safety of the laboratory for all lab members.

6. *The Community Part-time Members shall* continuously improve the laboratory spaces (e.g. physical, financial, and virtual) to fulfill the laboratory Mission and the expectations of this document.

7. *The Community Part-time Members shall* communicate all issues that jeopardize the expectations set forth in this document promptly to the Community Director.

NameSignatureDate
Never underestimate what a member can accomplish. Especially freshman.
**PERFORMANCE SPECIFICATION**

Professionalism, much like trust, can only be earned. However, the need to communicate expertise often arises when transitioning between careers. This Performance Specification Document is structured to

1. Focus efforts on value added to you, your project, and the community.
2. Structure these efforts in an easily communicable format for use in resumes and in interviews.
3. Serve as a contract that defines the scope of your work between you, your Community Member, and the Community Director.

**Your Origin Story**

Every interviewer is trying to figure yours out, so why not just have it ready? Every comic-book superhero has an origin story – a defining moment that reveals both abilities, weaknesses, and drive. What’s your Origin Story?

**Your Dream Team**

Nearly all comic-book superheroes end up in a complimentary Dream Team serving a community with recurring needs. What’s your Dream Team? What team do you want to be working with 5 years from now? What specific accomplishments/achievements will this team view as evidence of your ability to perform amongst their ranks?
The Story-arc of a Freakishly Awesome Achievement

Let’s make a plan for creating those accomplishments and achievements. We’re hard-wired to like a good story – including during interviews and discussions with family and friends. The long-term value of your work in the lab is ultimately related to the quality of the story you are able to tell about the work you did. Good stories have a few key elements that can guide your work:

1. **Challenge/Problem/Need/Motivation**: Why should we care about you and your problem? Why is it seriously challenging and hard?

2. **Background/Insight/Prior Art**: You’ve got to do some research to understand the problem and what has been previously done. Why is there a persistent gap in understanding that prevents the problem from being solved?

3. **Theory/Insight/Hypothesis**: When presented with a problem and the pressure and resources to solve, there is often a stroke of genius/insight that allows you to formulate your technical skills into a new or novel solution. Do enough back-of-the-envelope analysis to help us believe the idea has a chance.

4. **Application/Experiment/Work**: Now comes the difficult part – doing something new. Tell us the struggle. Use quantifiable metrics like number of trials, parts, etc.
5. Results/Findings/Improvements/Conclusions: Show us how the end result of your efforts solves or improves the problem. Why did this matter? Who does it help? How much does it help? What did you take away from the adventure?

You should try to have only one immediately convincing sentence in each of the above areas by the end of lab work. Do your best to draft examples now.

Making it Real

Now is the hard part – bringing this story to life by making it real. You need SMART Goals and Objectives (Specific, Measurable, Attainable, Relevant, and Time-bounded) supported by credible and quantifiable metrics (e.g. publications, external support, presentations to peers at conferences, etc.).

The overall goal/hypothesis/deliverable for my work is:

I will succeed in fulfilling/answering this goal/hypothesis/deliverable through pursuit of the following objectives/tasks:

(Please enumerate)
I will demonstrate completion/achievement of these objectives via the following credible deliverables:

(Please enumerate)

**Closure**

We do this so you don’t devolve into busy work. We’ll work together to get this document close at the start of your work. At the end of your work we’ll review this document, check to see if you fulfilled/answered your goal/hypothesis, and whether you completed your objectives in credible ways. We’ll then ask to hear your story. We want three before we’ll call you a pro. Let’s make them freakishly awesome!

NameSignatureDate
State your purpose.
In just five words.
~P.K.
**The Top Shelf**

Around this point it’s common for newcomers to ask, “What can I read to help me get up to speed?” That’s why we created “The Top Shelf” -- a collection of readings, to be grokked during your time in the community, that we believe will prepare members of our community to perform as professionals:


**Communication:** “The Elements of Style” by Strunk and White, “Language in Thought and Action” by S.I. Hayakawa, “If I understood you, would I have this look on my face?” by Alan Alda, “Visualizing Information” by Tufte, “Steel like an Artist,” by Austin Kleon.


**Safety:** “NFPA 2-2020: Hydrogen Safety Code,” “Engineering a safer world: A systems approach to safety,” By Nancy Leveson
THE HYPER COMMUNITY

A conversation similar to the following occurred shortly after the HYPER lab was founded in 2010:

P.K.: “What is the goal of HYPER?”
Jake: “Community.”
P.K.: “How long will it take?”
Jake: “4 years.”
P.K.: “It’ll take 8 years.”

While it’s not clear who won the argument, general consensus is that Community occurred in the HYPER laboratory somewhere between years 7 and 9.

HYPER exists not to be just a community, but a community of professional practice. A community of professional practice differs from a traditional community in that the performance is not trivial or capable of being taught through simple apprenticeship. Functioning communities of professional practice tend to display synergies allowing the collective to perform at a level more than the sum of the individuals alone.

Communities of Professional Practice require minimum amounts of the following:

1. Professionals
2. Shared Challenges
3. Resources
4. Cohabitation of space and time
5. Work and empathy.

While it’s primarily (though not exclusively) Jake’s responsibility to fulfill items 1-3, only you can fulfill 4 & 5. To help you with 4 & 5, the HYPER Community has developed a system for peer-to-peer communication and weekly Community meetings.

In 2020 WSU enabled MS Teams with our Office 365 subscription. Once you complete the MOU, you will be added to the HYPER MS Teams page. The HYPER MS Teams page has the following channels:

**General**: Required by MS.

**Announcements**: Exciting news about the community that all members should hear.

**Events**: Visitors, tours, and well, anything event like that happens at time.

**Finished**: Photographic evidence of completed tasks/projects/pursuits to be celebrated by the community.
**Job Postings:** Anything job related that is relevant to others in community.

**Professional Practice:** Tips for continuously improving ourselves.

**Random:** Everything else goes here.

**Safety:** Everything safety related.

**Team --:** Anything specific to the named project/experiment team.

The number of channels automatically displayed is 14, so you may need to manually add/hide some. Each channel has the ability to post key files as tabs at the top of the channel. Team/channel specific files will be posted here for group editing and quick reference. A simple question to ask before posting is, “Does this help improve the community’s professional practice?” And to be clear, both **Communities and Professional Practice are directly affected by the level of engagement.**

Although the digital presence helps to support the community, it cannot fully replicate in-person exchanges. The HYPER community has weekly meetings with the purpose of lab-wide updates and continuous improvement discussions.

[Revised lab meeting template will be posted here when ready.]

In the end, communities work because of cognitive surplus. We invest our energy and efforts into community because it makes us all better together, if we choose to.
Want to know what makes me tick?

Creating systems that foster communities of professional practice.
~Jake
TRAININGS

OVERVIEW
We have standardized the training process to minimize any gaps in knowledge while simultaneously establishing a standard for topic mastery. Our process employs a simple 3 step process: Learn One, Do One, Teach One. The first step involves some sort of learning via handouts, books, etc. The second step will involve applying that knowledge to a real project. The final step is to use your new knowledge and experience to design a project/system for application in the Community.

BOSCH-REXROTH CONSTRUCTION

1. LEARN ONE
We’ve assembled a series of informative visuals to help you learn the basics of the Bosch-Rexroth Construction.

   a. Go through the following visuals outlining the usage of Bosch-Rexroth materials we commonly use.
   b. Look over the Rexroth Bosch Group Systems manual provided on the Top Shelf.
   c. Using the resources from parts a and b, fill out the training guide that covers most of the issues we run into.
THE FRAMING THE LAB USES: 45MM X 45MM

- The standard in our lab
- Lightweight aluminum makes it easy to maneuver
- Order in pallets
- Cost per foot (as of February 2020): $5.80/ft

QUICK CONNECTORS

Equipment: Allen wrench, 2 tubes of 45x45 Bosch framing
Preparation: Milled hole in one piece of Bosch, using a jig for placement
Strength:
HOW TO USE A QUICK CONNECTOR

- Used to attach other items to a tube of Bosch (i.e. pegboards, wheels, etc.)
- Equipment: Crescent wrench, Bolt (T-Nut only)

T-BOLTS AND T-NUTS
GUSSETS

Useful for increasing strength of structure
Equipment: 2 T-Bolts, socket wrench

LEVELING FEET AND END CAPS

- **End Caps:**
  - Used to eliminate any sharp edges and for a more professional finish
  - Equipment: Rubber mallet

- **Leveling Feet:**
  - Used for the base of structures
  - Our lab size: M12x30
  - Equipment: Tap, Crescent wrench
Bosch Training Guide

Please complete this guide with the help of the provided PowerPoint and with the Bosch Aluminum Tube Framing catalog.

1. What size of Bosch Tubing does our lab use? What is the max applied force and moment on this? How many pounds on a 3-foot piece are allowable? (Ask for help if needed on this calculation. You may use the internet if needed to find conversion factors.)

2. What are the appropriate steps for using a quick connector? (Start from the preparation of the Bosch tube, and end at the installation of the connector. Please ask your colleagues, if necessary, for help on the milling steps.)

3. What equipment do you need to attach a gusset?
4. Where should you file the hole or the edge? (Circle all that apply)
   a. While the Bosch is still on the saw/mill
   b. After you have assembled your Bosch project
   c. Never- the edges after a cut aren’t usually that sharp anyways.
   d. Over the garbage can after cutting/milling

5. What are acceptable ways to remove metal chips from the mill? (Circle all that apply)
   a. With an air gun
   b. With a brush
   c. With a vacuum
   d. Leave them there in case you need it again soon.

6. What is the size of leveling feet that we use in our lab? What size tap do you need to prepare the Bosch for the installation of a leveling foot?

7. Assign numbers 1-4* to each connector (where 1 is weakest and 4 is strongest) for the maximum applied force for:
   Quick Connector       T-nuts       T-bolts       Gussets

*Note: If two components are of equal strength, assign them the same number and adjust the scale to be 1-3.

8. List 3 things that you have found in the catalog that you didn’t know and that are useful for the lab.
ANSWER KEY:

1. 45mm X 45mm, 1200 N and 53 Nm, 10.9 lbs
2. Follow these steps:
   a. Attach jig to the end of the piece of Bosch, so that it is flush with the edge.
   b. Set up mill to line up with the jig from previous step.
   c. Remove the jig.
   d. Mill the hole.
   e. Brush and file the hole to get rid of sharp edges and shavings.
   f. Place quick connector in milled hole.
   g. Use the bolt to connect two pieces of Bosch.
   h. Use an Allan wrench to tighten quick connector.
3. 2 T-bolts, a socket wrench.
4. A, D
5. B, C
7. 3,1,1,2

Gussets: 3000N, 36Nm
T-nuts and T-bolts: 12000N
Quick Connectors: 4000N, 140Nm (Based off a quick connector with a D value of 17 (see pg. 15-6 of Bosch handbook)

8. Your choice

2. DO ONE

Work with others in the lab to complete a task utilizing Bosch for the lab. Jake will decide what you will build, and the assembly instructions will be provided

- Previously Completed Builds:
  i. Adams-Brown-Waldschmitt (ABW) Desks:  
  ii. CLEAN (Cougar-LEAN) Benches:
     https://hydrogen.wsu.edu/2017/06/19/clean-workbench-assembly/

3. TEACH ONE

Bosch is incredibly useful in creating assemblies that will benefit the entire lab. In this final section, please design and build a system (designated by Jake and Mark) for the community using Bosch-Rexroth framing. The final deliverable is a Lego inspired instruction manual (i.e. no words required) for constructing your build.

- Current needs:
i. Improved cleaning cart.

ii. Versatile rolling carts that can be used for soldering, assembly, MLI, etc.

iii. Machine shop door modification.

iv. Anywhere you see a need.
SAFETY
1. Learn One
2. Do One
3. Teach One

CRYOGENICS
1. Learn One
2. Do One
3. Teach One

VACUUM/PLUMBING FITTINGS
1. Learn One
2. Do One
3. Teach One

PROFESSIONAL PRACTICE
1. Learn One
2. Do One
3. Teach One
TRANSCENDING

Applying + Resumes
https://hydrogen.wsu.edu/2015/10/16/read-this-before-you-ask-me-for-a-reference-letter/
https://hydrogen.wsu.edu/2017/03/11/how-to-write-a-resume/

Interview Notes
(Include notes on interview processes from key companies.)

Negotiating
https://hydrogen.wsu.edu/2018/11/05/its-like-teaching-engineers-how-to-negotiate/

The Importance of Life-long mentorship

Stories From The Road