Iowa State University

College of Engineering

Lab Tour Script

Fall 2019

Stop Location	Information
Marston Hall (Harpole Welcome Center)	Introductions, handing out safety goggles
Coover (TLA)	Transformative Learning Area Lab
Coover (west lobby or outside west doors)	Civil and Construction lab space
Sweeney (Unit Operations Lab)	Chemical Engineering Lab
Biorenewables Research Lab	Biorenewables Lab
Biorenewable Sukup Hall	John Deere Engines Laboratory
Biorenewables Sukup Hall	Student Innovation Lab
Howe (first floor, by main doors)	VRAC/Aerospace
Howe (downstairs, M2I lab, 0620)	Make 2 Innovate lab
Hoover (Boyd lab, Caterpillar lab)	Mechanical engineering labs
Hoover (atrium)	Materials engineering

Marston Hall

Pre-Tour Activity & Demos – First floor, Harpole Welcome Center

Make sure to hand out safety glasses to guests. These will need to be collected after the tour ends.

Introductions:

- Name
- Major
- Hometown
- Fun Fact (if you want)

Welcome to the College of Engineering at Iowa State University. We currently have twelve different majors that reside in eight different engineering departments. During this tour, we will be walking through a variety of lab spaces. We ask that you please make sure that your safety glasses are on when entering lab spaces. Does anyone have any questions before we begin?

We are currently in Marston Hall. Engineering Student Services is on the first floor of this building. This area includes services such as engineering international programs, scholarships, classification, recruitment, and undeclared engineering academic advising. Marston Hall also houses Engineering career services, high tech classrooms, student conference/meeting/and study rooms along with the college administrative offices.

Iowa State University is home to one of the largest campus public art collections in the United States. We used to have Iowa Art in State Buildings legislation, which required .5 percent of new construction or remodeling funds to be used to acquire public art.

If you entered Marston through the East doors, you may have noticed the artwork hanging from the ceiling. It's called The Fifth Muse. Referring to the four Marston Muses on the outside of this building, this artwork looks at the present and into the future of Engineering as well as the past, and expresses for the current time what the original muses expressed about engineering for its time.

This artwork is anchored by the basic wheel, an early engineering invention, and the turbine, a more recent invention connected by an infinity symbol as its main structure from which over 100 objects hang. The objects were produced in several of the labs and manufacturing facilities at Iowa State.

Coover Hall

Enter Coover through East doors and briefly mention CYRIS (the multi-touch display in the entrance that students get to program apps for). Walk through Coover and stop inside the TLA space. If it is being used heavily, talk outside the room, but still walk through.

Transformative Learning Area (TLA)

The Transformative Learning Area is a collaborative learning space designed with functionality in mind. In addition to banks of PC and Linux machines, students have access to state-of-the-art lab equipment. For example, to test circuits, there are digital multimeters, oscilloscopes, signal generators, and power supplies. This space is also designed to be adaptive to future changes in curriculum and trends in electrical and computer engineering.

The arcade and pinball machines in the back are former senior design projects – designed and built by student teams.

Civil, Construction, and Environmental Engineering Labs

Talk outside of Coover while pointing to Town or inside the West Coover entrance in bad weather.

The teaching and research labs in civil, construction and environmental engineering are located in Town Engineering Building *(point to Town Engineering Building).* Actually, almost *every civil, construction and environmental engineering class* has a certain hands-on component. Students and faculty use the labs to test the strength of bridges and beams, develop new materials, and find out the chemical makeup of by-products.

One example is the Anderlik Teaching Laboratory. This lab has specialized equipment to analyze air, water and wastewater. In this lab, professors and students explore better ways to recognize and solve environmental problems, both today and for the future.

The department has several newly-renovated computer labs with special spaces dedicated to student collaboration and team projects.

This department collaborates with both university and industry partners. Examples are the Iowa State University Institute for Transportation and construction industry leaders. These groups organize co-ops, internships and mentorship opportunities.

Exit Coover through the West doors and cross street using the cross walk towards Sweeny Hall.

Sweeney Hall

Herbert L. Stiles Undergraduate Teaching Laboratory
Room 1053/2053/2059 Sweeney Hall

This is the Unit Operations Laboratory also known as the Herbert L. Stiles Undergraduate Teaching Laboratory. All undergraduate chemical engineering students are required to take two laboratory courses, which are held in here. As juniors, they do experiments that apply the concepts taught in the fluid mechanics, heat transfer, thermodynamics, and kinetics courses. As seniors, they do experiments that are more complicated, and include topics studied in the mass transfer, separations, reaction engineering, and process control courses.

The courses emphasize applying theoretical concepts learned in the classroom to real process equipment, and understanding of process safety and hazard identification. Many of the measurement devices are from the same manufacturers who supply power plants, oil refineries, paper mills, grain milling plants, and many other processing facilities.

One of the more complicated experiments conducted in this laboratory involves the distillation process. The equipment involved (seen in the background – in the southwest corner of 1053) has two separate components - the distillation column and the control system. The control system is used to monitor and control the column, and it is the same system used in many industrial facilities. The standard, pilot-sized column is the same as one seen in a refinery or chemical plant.

Biorenewables Complex

Enter through East doors (main doors) into the Sukup atrium and go into the Biorenewables Research Lab for this stop. Do this stop in front of the Biobus Lab so guests can look through the windows.

Biorenewables Labs

ISU BioBus is an interdisciplinary entrepreneurial student initiative that recycles waste vegetable oil from ISU Dining into biodiesel fuel that can power the City of Ames' CyRide buses. *(This is the lab on the Southwest Corner on the first floor of BRL).*

Artwork on display here is part of the Biorenewables Art Competition. This competition is open to Iowa State Students enrolled in design courses. Artwork reflects the Bioeconomy Institute's mission which is economic, environmental and social sustainability to advance development of biorenewable resources for the production of fuels, energy, materials, and chemicals.

Exit the Biorenewables Lab area and walk to the Sukup Hall lab area to do this stop in front of the John Deere Engines lab.

Elings Hall (south building – pronounced ee-lings). Classrooms and office space for the department of Agricultural and Biosystems Engineering.

Sukup Hall (west building – pronounced soo-cup). Research laboratories, teaching laboratories, student workshops, research workshops, student teaming rooms and student computer labs for the department of Agricultural and Biosystems Engineering.

Biorenewables Research Laboratory (north building – usually called BRL). Office and laboratory space for the Bioeconomy Institute and the Center for Biorenewable Chemicals. Research includes using biomass (organic material of recent biological origin) for energy, chemicals, and materials.

The three buildings, along with the **Sukup Atrium**, is called the **Biorenewables Complex**.

John Deere Engines Laboratory & Automated Manufacturing Laboratory
1219 & 1223 Sukup Hall

Look into the two laboratories from the windows facing the atrium.

Diesel engines are a critical tool in the world's economy for improving productivity. Diesel engines are used to haul freight, till fields, move water, harvest crops and generate electricity around the globe. In this laboratory, students study and learn about diesel engines by disassembling and reassembling the engines. In other labs, students use transmission and engine dynamometers to run tests to determine engine performance under varying load conditions and understand propulsion control systems for off-road vehicles. They then model the performance and transmission control of a diesel powered off-road machine under load using modern engineering software.

The Automated Manufacturing Laboratory contains several large CNC lathes and milling machines that are common in manufacturing plants around the world. Just like in industry, students design a part using CAD software and generate code using CAM software that will allow the CNC mills and lathes to automatically machine the design out of a solid block of material. This process often involves many steps, thousands of lines of code, and multiple tools in order to achieve the final product. Students preparing for careers in manufacturing get hands-on experience using CNC, CAD and CAM technology.

Student Innovation Center Lab
1209 & 1215 Sukup Hall

Enter the North door to the lab using the key code for the door.

The ABE Waterjet uses water or water and abrasive to mimic the process of erosion that occurs in nature. The water jet utilizes filtered tap water that flows into the machine and is then pressurized to 60,000 psi. An abrasive material similar to 80 grit sandpaper is mixed with the water and directed through a small opening to cut through materials like steel, plexiglass and rubber. Pieces are cut based on two-dimensional drawings submitted using AutoCAD, Solidworks or Autodesk Inventor, for example (Point to example on workbench) - the waterjet is slower than plasma and laser cutters but is more precise and the cold-cutting process does not heat or warp the materials.

Sophomore students take a Project Management Design course that emphasizes project management before their first internships. The students work in groups on two projects before splitting off into specialty areas (biosystems or power machinery) for their final project. The first project students complete is the creation of a mobile utilizing CAD software and the water-jet cutter.

The second project (point to blue Styrofoam box near ceiling) involves data sensors. A lightbulb is placed inside the box and, based on the data produced by the sensors in regard to temperature and air flow, students must determine the wattage of the lightbulb. This project teaches students how to manage the amount of energy and heat that into systems. After this, students branch off to their final projects. Power machinery students design and build robots. Biosystems students work on bioreactors.

In addition to the waterjet and the project management course, the student innovation center provides lab space for senior capstone projects, lab space for the Society of Manufacturing Engineers club, is home base of the Cyclone Power Pullers, and houses a 3-D printer and fabrication and welding equipment.

Howe Hall

Virtual Reality Applications Center

The Virtual Reality Applications Center (VRAC) is an interdisciplinary research center focused at the intersection of humans and technology, aimed broadly at enhancing the productivity and creativity of people. The most impressive tool within the VRAC is the C6. The C6 is a 10ft. cube that uses 24 high resolution projectors to display color images on the four walls, the ceiling and the floor of the room. Researchers and other participants are completely immersed in a detailed virtual environment once they enter the C6. Being one of the highest resolution immersive environments in the world with over 100 million pixels, it is not a surprise to see many outside companies using this technology. John Deere has software developed at VRAC to redesign their tractor cabs; medical doctors are using tools created at VRAC to see 3-D models of their patients before conducting surgery.

Aerospace Engineering

Howe Hall is also the home to aerospace engineering. We have many cool labs in this building:

Wind Tunnels
The building contains five wind tunnels with a range of sizes. One is so small that it can reach speeds of Mach 3 (three times the speed of sound), and another is large enough that it can hold a full scale Volkswagen Beetle. Students have the opportunity to use these wind tunnels in lab classes or as a part of undergraduate research work. We also have a tunnel that simulates what happens when ice forms on objects immersed in flow.

Tornado/Micro-burst Simulator
This simulator has capabilities to produce a micro-burst jet or a tornado-like vortex that can be used for model testing, for instance on a small scale model of a city or landscape. The vortex can reach up to speeds of 55 mph.

Flight Simulator Lab
This lab contains desktop simulators that provide students with a detailed, immersive, and challenging flight experience.

Structures and Composites Lab
This lab allows students to look at new ways of minimizing weight and still maintain strength for structural components with the use of products such as carbon fiber weaves.

Rapid Prototyping Lab
Students use a computer-controlled foam cutter to make airplane wings. They also build real tires directly from a computer drawing using a plastic prototype.

Airplane:

The student group AirISU built the airplane, the Zodiac XL, at the West end of the atrium from scratch in 2013.

Make to Innovate (M:2:I) – Ground floor
0618 & 0620 Howe Hall

If class is in session, have guests just look into 0618 – do not interrupt the class. Take the guests into 0620 near the 3D printers to talk.

The aerospace engineering department teaches a course in the lab that we just went through for first-year aerospace engineering students. Students use PYTHON to do engineering programming and problem solving for projects like making a lighter than air vehicle. This course also includes guest lectures – for example Clayton Anderson, former astronaut and current faculty member.

Although based in aerospace engineering, the Make to Innovate or M:2:I program is a multidisciplinary program designed to give students hands on experience in engineering. Projects have ranged from underwater to space and everything in between and involve students from nearly every engineering program on campus. Students working in the M:2:I lab have created a Mars Rover and competition rockets. They fly high altitude balloon payloads to over 100,000 feet, and are preparing to launch a small satellite into space in 2019. The 0620 lab is a workspace that M:2:I students can use for the design and fabrication of their projects.

M:2:I also offers space to the rapid prototyping and fabrication service center allowing an area with printers that can print moving parts as well a printer that can print with two materials at one time to create a 3D object. This allows not only M:2:I students, but any entity on campus the opportunity to fabricate parts needed for class designs, research, and personal projects. [*Can show examples if there is time].*

Exit through main entrance on first floor of Howe.

Black Engineering

Point to Black Engineering while walking to Hoover and mention that it houses Mechanical and Industrial Engineering labs.

Hoover Hall

Enter Hoover Hall through west doors and give this stop outside of Boyd Lab.

The HIVE

The HIVE identifies the area in Hoover that is used by Mechanical Engineering. It encompasses the Boyd Lab, Caterpillar Lab, computer lab, and lab instructor's offices.

Boyd Lab (Fabrication Lab)

Equipment is used for:

- Woodworking
- Metalworking
    - Including manual mills, lathes, and a welding shop

Boyd Lab supports classes and any ISU related projects, as long as they are not personal:

- Sophomore Design Course
    - ME 270 projects aim to support economic activity in developing regions.
- Senior Design Courses
    - ME 415 projects are industrial-sponsored projects giving students a hands-on experience solving applied industrial problems.
    - ME 466 projects connect multi-disciplines such as mechanical, electrical and aerospace engineers in the solution of a single design problem (a lot of times Industrial Design is involved too with some of the projects in this class in the past).

Examples in the Window:

- Solar car and Baja car teams often make parts for their vehicles in this lab-they will first CAD a part and then use one of the 3D Printers to make a rapid prototype. After proving concept with the plastic part they will then use the CNC Mill to make the final part using aluminum.
- A Peanut Sheller designed for a village in Africa that uses peanuts as its cash crop
- A simple machine that condenses a paper and wood slurry down into a coal that burns hotter than the raw materials in their original states
- Peanut butter maker. Previously, the women in this particular African village were using a mortar and pestle to grind the nuts into butter.
- Electricity Hand Crank

Walk through the Boyd lab, unless it is too busy then walk around to the northwest corridor around to the Caterpillar lab.

Caterpillar Lab

Talk in the hallway, do not stand in between the doors to the Boyd Lab and the Cat Lab so people can walk through.

Design is a major component of mechanical engineering education at Iowa State University. At least four mechanical engineering courses focus on a semester-long design project in which students apply their knowledge of engineering science to real problems.

The first few weeks of class is teaching the theories and processes of designing in which the teams conceptualize their designs utilizing the computers that have been integrating into their work benches. The students will then start the hands-on portion of the design class where they build what they've designed.

Students will take pieces they have worked on in the fabrication area (which we will see next), and use this area for testing and assembly. The students gain access to the hand tools and testing equipment kept in the Grainger cabinets after the students have passed the required safety modules online. Testing equipment ranges from simple spring scales to a variety of highly accurate computer integrated load cells. So you could measure the power generated by peddling a bicycle-operated battery charger, and then in turn be able to charge a cell phone.

Measuring Tools:

- Force Gauges
- Volt Meters
- Tension and Compression Load Cells are hooked up to a computer to measure forces. For example, you could attach them to a handle of a bucket that goes down into a 30 foot well to measure the amount of force it takes to pump the water out.
- Spring Scales measure how much force is needed to pull something. You could determine if the tool you created to be used in a third world country would require a burly man to pull on the tool, or if a small woman, who would actually need to use the tool, would be able to maneuver it.

Materials Science Engineering Teaching Labs

Walk down to the main atrium by the staircase for this stop.

The teaching laboratories in the materials science and engineering department in Hoover Hall are mainly on the upper floors of this building. They use tools and techniques such as electron microscopy, optical microscopy, x-ray diffraction, thermal analysis, and spectroscopic analysis to study high-tech ceramics, metal alloys, and polymeric/plastic materials.

Students get hands-on experience with these devices and learn to develop protocols to evaluate how practical materials are as well as to assess the design of new materials for use in industries including manufacturing, automotive, and aerospace. A recent senior capstone design project, for example, evaluated a new generation of lead-free electronic solder materials for their resistance to corrosion.

Collect safety glasses and exit Hoover through the main North doors, towards the water tower, and direct guests to their next location.