From: [redacted]
Sent: Thursday, August 15, 2019 10:49 AM EDT
To: [redacted]
Subject: RE: Prototyping Lab - Write up for TJPF
Attachment(s): "Prototyping Outline PF.pdf"

Hi [redacted]
I hope you've had a good summer. Attached is something I worked on for [redacted]. I used [redacted]'s Chem Research as a template. Please let me know if I you'd like me to make any changes.

Thanks
[redacted]

From: [redacted]
Sent: Monday, June 10, 2019 1:17 PM
To: [redacted]
Subject: Prototyping Lab - Write up for TJPF

Hi [redacted],

I hope you are doing well.

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Please let me know your thoughts and if this is possible.

Thanks,
[redacted]

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Thomas Jefferson High School for Science and Technology
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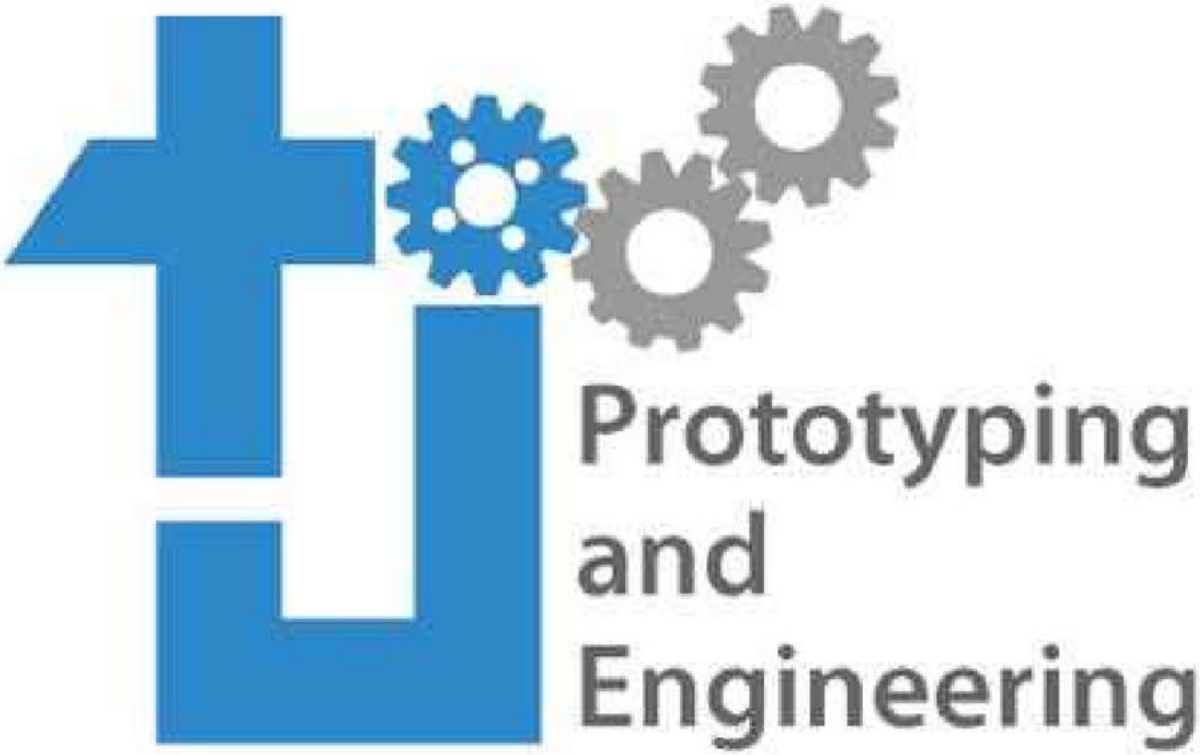
Thomas Jefferson High School for Science and Technology
[redacted], Director, Prototyping Research Lab

Prototyping Elective classes and Prototyping Research Laboratory

A. Curriculum and schedule for each grade
B. Establishment, implementation, and evaluation process for each student's project
C. Information on number of students for each team project and Information on how many projects are guided by the Prototyping Lab Director
D. Information on how students are selected for the Prototyping Lab
E. Information on how the Prototyping Lab Director provides targeted guidance for each project
F. Prototyping Lab Management system.



A. Curriculum and schedule for each grade.

- Prototyping Development 1 – Grade 10 or 11
- Prototyping Development 2 – Grade 10 or 11
- Prototyping Research – Grade 12

Curriculum Overview

Prototyping Development 1 This course is intended for those students who wish to pursue a career in engineering, industrial design, product design, or manufacturing. This is an introductory course designed to introduce students to a variety of skills and techniques used to design and develop products. Students learn how to safely use and operate basic hand tools and machinery through a series of instructor-led projects. Topics include material properties and processes, precision measurement, basic welding, Computer Aided Design (CAD), and Computer Controlled (CNC) machining.

Prototyping Development 2 This course-builds upon the knowledge learned in Prototyping 1 by introducing more advanced techniques and open-ended design projects, and aims to prepare students for the Prototyping Research Lab by requiring them to develop and create custom solutions to specific problems. Students will learn how to program and operate advanced Computer Controlled (CNC) machinery such as a CNC mill, lathe, router, and waterjet. Prototyping Development 1 is a pre-requisite for this course.

Prototyping Research This course provides students an opportunity to use the engineering design process to complete a research project. Students will use Computer Aided Design and Manufacturing (CAD/CAM) software to develop components that will be fabricated and assembled in the lab using both traditional and Computer Controlled (CNC) machinery. Research topics may include, but are not limited to: assistive devices and prosthetics, complex mechanical prototypes, human powered devices, and space saving and mechanical furniture. The laboratory accommodates both individual and group projects.

B. Establishment, implementation, and evaluation process for each student's project

The following are essential expectations and submission requirements for all students:

Every student in the Prototyping Research Lab program must fulfill several requirements. Grades will be based upon the degree to which these are met, and the quality of the work completed. Each student will be required to:

- Technical Journal. This details any progress made or setbacks that have been encountered. Completed weekly and stored online.
- Bi-weekly progress reports. Presented to either the class or teacher.
- Perform Background Research / Literature Searches of peer-reviewed scientific journals.
- Prepare a Research Project Pre-Proposal (individual)
- Prepare a Research Proposal (individual)
- Prepare Construction Documents to include: CAD/CAM Drawings 3d solid model, working drawings, and presentation drawings, electrical schematics, g-code, Bill of Materials, Process Flow Chart and Order of operations
- Complete Research Project
- Adhere to all necessary Lab Safety Practices.
- Write a Final, Technical Research Report (counts as Final Exam = 10% of grade)
- Prepare a final formal Presentation and Poster summarizing the research project.
- Participate in TJ STAR and Science Fair competitions, compete for Intel Awards, etc.

Students are evaluated in the following areas, several times per quarter:

- Research Progress
- Daily Preparedness and Use of Time
- Independence and Higher Level Thinking Skills
- Lab Safety
- Research Journal

C. Information on number of students for each team project and information on how many projects are guided by the Prototyping Lab Director

The number of students enrolled in the Prototyping Research Lab ranges from 20-30 students depending on the year. Class size is limited to 16 students per section due to safety concerns. Approximately 1-3 additional students participate in off-campus research through the TJ Mentorship Program. For research conducted at TJ, students may work individually or in a small team. If working in a small team, each student will be responsible for the research and development specific component or system that will then be integrated into the larger project.

D. Information on how students are selected for the Prototyping Lab

Students must complete both Prototyping Development 1 and Prototyping Development 2 prior to being admitted to the lab, exceptions will not be made. Work on projects usually begins during the Junior year in the form of topic research and proposal writing. This enables adequate time for acquisition of materials and thorough development of ideas. Students must expect to begin literature searching, idea development and proposal writing prior to the start of their senior year. Since Prototyping overlaps with many science and technology areas, students are encouraged to collaborate with other technology labs in the development of their ideas and in the completion of projects.

Guidelines for Admission:

1) Approval by Lab Director for all components and pre- or co-requisite courses.
2) Submission of preliminary proposal in accord with Research Lab requirements (see separate handout).
3) Acceptance of preliminary proposal in terms of viability, resource availability, etc. Students must be certain that TJHSST has the equipment needed for proposed research. Limited funding may be available for basic supplies and materials.
4) Completion of preliminary proposal over the summer, due at end of 1st week of school.

TJHSST has the following equipment that students can consider to be used to develop projects and experiments:

- CNC Milling Machines with 4th and 5th axis capabilities
- CNC Lathes
- CNC Router
- CNC Waterjet
- Manual Metal Lathes
- Manual Milling Machines
- Vibratory Tumbler
- Ironworker
- Programable Tubing Bender
- Sheet Metal Shear
- Sheet Metal Forming Tools
- Welders (Mig/Tig/Arc)
- Portable Plasma Cutter
- Drill Presses
- Table Saw / Shaper
- Band Saws
- Wood Lathe
- Table Router
- Jointer/Planer
- Injection Molding Machine
- Precision Measurement Tools
- Various Hand Tools (wood/metal)

E. Information on how the Prototyping Lab Director provides targeted guidance for each project.

The following is a summary timeline of events for students:

1) 1st Quarter: background research begins
    (a) Project Pre Proposal
    (b) Background Research / Literature Review
    (c) Creating Objectives
    (d) Final Proposal
2) 2nd Quarter: project design and construction documents
    (a) 3d Modeling in CAD Software
    (b) Generate Bill of Materials
    (c) Begin Ordering Materials
    (d) Create Working Drawings / Schematics
    (e) Process Flow Chart / Order of Operations
3) 3rd Quarter: fabricating and assembling project
    (a) Collect and Process Raw Materials
    (b) Fabricate Necessary Components
    (c) Assembly
4) 4th Quarter: testing/redesign and final paper / presentations
    (a) Testing and Analysis
    (b) Redesign if Necessary
    (c) Write Final Report
    (d) Present Research Project

Sample Prototyping Projects Categories and Projects

- Assistive Devices
    - "3rd" Hand to Help a Double Amputee Wounded Warrior in the Workshop
    - Prosthetic Limb for a Small Dog
    - Disaster Relief Shelters
    - Brain Controlled Wheelchair (Collaborated with Neuroscience)
- Complex Mechanical Devices
    - Orrery
    - Small Rotary Engine Model
    - Small 4 Cylinder Engine Model
    - Small CNC Router
- Vehicles
    - Solar Car (collaborated with Energy Systems)
    - Diwheel
    - Foldable Bicycle
    - Vacuum Powered Wall Climbing Device
- Other
    - Biomimetic Fish (collaborated with Oceanography)
    - Space Saving Nesting Furniture
    - FIRST Robotics (collaborated with Robotics)

F. Detailed Safety Rules

Safety is a crucial part of working in the lab. Following proper safety procedures ensures that nobody gets hurt and we all have a safe environment to work in. Any safety violation will result in removal from the lab and the student will receive a class participation grade of 0 for the day. After the 3rd safety violation, the student will not be allowed into the lab and an alternative curriculum will be provided in order to complete the course. The following safety rules are to be followed at all times in the lab.

- Safety Glasses must be worn at ALL times while working in the lab.
- Closed toed shoes must be worn at ALL times while working in the lab.
- Tie back long hair.
- Remove or roll up loose articles of clothing and/or jewelry.
- Earbuds / headphones are not permitted in the lab.
- Secure approval of instructor before working in the lab.
- No running or horseplay in the lab.
- No shouting, screaming, or yelling in the lab.
- Be courteous of others in the lab, do not distract them while using a machine, wait for them to finish before talking to them.
- Keep floors and tables clear of tools and debris.
- Do not look directly at the plasma cutter or welder while in use unless wearing proper eye protection. (ie welding hood)
- Put tools away when finished.
- Wash your hands at the end of each class period.
- **REPORT ALL INJURIES TO TEACHER IMMEDIATELY, REGARDLESS OF HOW MINOR.**

Lab Clean Up Procedures

Maintaining the lab is just as important as the safety procedures you will follow when in it. By cleaning the machines and putting hand tools in their proper location allows the tools to function properly and safely when you need to use them. It also prevents unnecessary wear and tear on equipment from debris.

At the beginning of the course you will be assigned an area of the lab that you will be responsible for maintaining. With 10 minutes left in each class you will stop working on your projects and begin to clean up. Put away and clean off the tools/equipment you are using and then begin to clean your assigned area. When cleaning your area, be sure to put away any tools that may be left out, clean off/dust any tables and machinery, sweep the floors, and throw away any trash or scrap. By maintaining the lab you will make working in the lab much more enjoyable and won't have to spend extra time searching for that one tool that you can't seem to find.

LAB CLEAN UP WILL BE FACTORED INTO THE CLASSWORK GRADE

G. Prototyping Lab Layout Considerations

Figure 1 provides a floor plan and equipment layout for the Prototyping Research Lab. The lab was designed to have designated spaces for each of the following

- Independent Classroom: Area isolated from the lab space for lectures and computer work. Safety equipment does not need to be worn in this area.
- Metalworking Area: Contains both CNC and Manual machinery such as lathes, mills, waterjet, etc. Also has large workbenches with metalworking vises for students to work on projects.
- Woodworking Area: Contains machinery such as CNC Router, Tablesaw, Jointer/Planer, Bandsaws, etc. Also has large workbenches with woodworking vises for students to work on projects.
- Welding Area: This area is separated from the rest of the lab with UV protective welding screens. Fume extraction hoods are located over specialized welding fixture tables.
- General Material and Project Storage: Includes large storage racks for sheet material and long lengths of bar/tube. Large open shelving for student projects and a flammable cabinet for hazardous material.
- Lab Safety Equipment
    - Emergency Power Shutoffs located throughout the lab
    - Eyewash station
    - Safety Shower
    - Fire Blanket
    - Fire Extinguisher
    - Safety Glasses for ALL students
    - Welding Mask/Gloves/Jackets for each student in the welding area
    - Face Shields for metal grinding and wood turning operations
- Other Facility Considerations:
    - Overhead busbars for power to allow flexibility and growth
    - Large amount of compressed dry air available with several drops located throughout the lab
    - There should be a minimum of 12’ clearance between floor and lowest hanging light/busbar/etc
    - In floor sump in metalworking area to aid in cleanup of spills
    - Centralized dust collection system that connects to all woodworking machinery and automatically turns on when machinery starts up
    - Large roll up doors for moving equipment and materials into the lab

While working in the lab students are always expected to follow safety procedures with NO exceptions. Any student found violating safety procedures is immediately removed from the lab and their parents informed. If safety concerns continue, alternative assignments are provided.

Security - Critical Infrastructure

From: [redacted]
Sent: Thursday, August 15, 2019 10:58 AM EDT
To: [redacted]
CC: [redacted]
Subject: Re: Prototyping Lab - Write up for TJPF

Thank you! I'm so grateful. I hope you also had a nice summer. It's gone too fast.

If you get me an invoice we can get you paid!

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