



G-E-T High School Curriculum
Align, Explore, Empower
Scope and Sequence
Metals 1

Unit 1 - (Safety and Machine Training)

(Length of Unit - 2 weeks/ongoing)

Students will get trained on the lathe, mill, cnc plasma and cnc mill. Students will be required to complete several safety tests prior to using the machines on a daily basis. Students must be present during machine demonstrations and answer several questions before practicing and identifying various parts. Students will be required to read blueprints and use precision measuring equipment to design and create various projects on the lathe, mill and cnc equipment. Students will have multiple formative and summative assessments throughout the class on safety, proper dress and hazardous areas and concerns.

In this unit, students will ...

Recognize and demonstrate shop safety during the use of tools and equipment.

Students will set up, run, and clean up daily on the metal lathe and vertical milling machine. Students will recognize shop hazards and potential areas of concern.

Students will identify the parts of the lathe, mill and safety rules of operation.

Identify occupation dress and hazardous materials.

-pants, closed toed shoes/steel toe, long sleeve shirt, safety glasses, ear protection, heavy lifting, common chemicals, MSDS sheets, Lock-out/Tag-out, etc.

Standards for (Metals 1)

MNF1.a.7.h: Identify safety and health protections and procedures that are critical to worker well-being.

MNF1.c.6.h: Learn how to cooperate with others in ways to exhibit respect for individual and cultural differences and for the attitudes and feelings of others.

MNF1.c.7.h: Recognize characteristics and benefits of teamwork, leadership and citizenship in school, community and manufacturing settings.

MNF1.h.7.h: Demonstrate the proper safety and use with plasma cutting equipment.

ENG5.b.7.h: Operate systems so that they function in the way they were designed.

PE1.b.11.h: Demonstrate and follow proper safety procedures for tools and machines used in power and energy systems.

Unit 2 - Precision Machining

(Length of Unit - 1 week/ongoing)

Students will get trained on multiple measuring devices - micrometer (inched and millimeter), depth gauges, calipers (vernier, dial and digital), steel rule (1/64th), gauge blocks, etc. Once the students understand how to read each measuring device and have completed other assessments; they will be required to use those precision measuring tools throughout the course on various projects. Students will work in small groups on multiple assessments to increase their knowledge and hands-on experiences with all precision measuring devices.

In this unit, students will ...

Be able to read and demonstrate how to properly use precision measuring tools.

Students will calculate and illustrate how to use inch-based micrometers, metric-based micrometers, dial calipers, dial indicators, 1/64th steel rule and depth gauge.

Students will use micrometers and steel rules to accurately measure their final products.

Standards for (Metals 1)

MNF1.a.8.h: Use appropriate tools, materials and machines to repair a malfunctioning system.

MNF1.a.9.h: Select and apply the appropriate units and scales for situations involving measurement.

ENG4.b.5.h: Develop and produce a product or system using a design process.

ENG5.b.7.h: Operate systems so that they function in the way they were designed.

ENG5.b.9.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

Unit 3 - (Blueprint Reading)

(Length of Unit - 1 week/ongoing)

Students will be required to read blueprints in order to design and create multiple projects on the lathe, mill and cnc equipment. The students will get trained on blueprint reading by using blueprints found in the local industries in the area. Class discussions and instructor explanations will be used to expose the students to blueprint reading. Students will work in small groups and independently on multiple assessments to enhance their understanding on blueprint reading. Those assessments will be used to determine when they can start working on projects.

In this unit, students will ...

Be able to read and demonstrate how to properly use blueprints within the metals world.

Students will follow lathe and mill blueprints to produce quality products and select proper materials.

Standards for (Metals 1)

ENG5.b.9.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

MNF1.a.9.h: Select and apply the appropriate units and scales for situations involving measurement.

MNF1.c.9.h: Identifying various strategies to conflict resolution and their importance for a variety of situations.

Unit 4 - (Speeds and Feeds)

(Length of Unit - 1 week/ongoing)

Students need to know how to set the machine up and get the machine running to the correct speed based on the material they are cutting. Students need to understand the difference between ferrous and non-ferrous materials and the hardness of the material. Cutting the material at the wrong speeds and feeds can damage the tooling, machine and have a major effect on project quality. Once the students understand how to calculate the proper speeds and feeds given various material options, they will use that skill and apply it to their projects. Students will be required to set their machines based on rough cutting and finish cutting. The students will use charts and formulas to help find the proper speeds and feeds.

In this unit, students will ...

Distinguish cutting speeds, feeds and tool geometry based on material selection and surface quality.

Students will be able to properly set up the lathe or mill based on the material being cut, cutter type and allowance of surface roughness.

Students will recognize aspects of cutting tool geometry, its purpose and its function

Students will be able to recognize proper RPM and FPM based on product quality.

Identify and explain properties of metal - ferrous and nonferrous

Students will be able to classify that all metals are either ferrous or non ferrous. Ferrous metals are iron based and non-ferrous metals are considered precious metals. Moreover students will be able to identify certain metals as ferrous or non-ferrous.

Students will be able to identify and explain the major properties of metal: hardness, toughness, tensile strength, thermal, elastic, malleability, etc.

Standards for (Metals 1)

BB1.a.5.h: Describe how systems can fail because of design flaws, defect parts, poorly matched parts or they were used beyond their design capabilities.

BB1.b.5.h: Select appropriate resources and explain how trade-offs between competing values, such as availability, cost, desirability and waste influenced their decision.

MNF1.f.8.h: Recognize technologies provide a means for humans to alter or modify the materials and to produce products.

ENG5.b.7.h: Operate systems so that they function in the way they were designed.

Unit 5 - **(CNC Machining)**

(Length of Unit - 3 weeks)

Students will get hands-on experience using the cnc mill and cnc plasma to create projects and learn how current metal manufacturing is utilizing cnc machining in the local industries. Students will take several shop visits to Fastenal, Stellar Molding and Gea Technologies to better understand the cnc world. Students will work in smaller groups and get training from the instructor prior to using the cnc equipment. Students will be encouraged to help each other and create additional projects on the cnc equipment during ELT. The biggest thing the students need to illustrate is the machine set-up, workpiece layout and all the proper tooling needed to complete the projects.

In this unit, students will ...

Identify and explain the advantages and disadvantages of CNC machining and laying out workpieces and prototyping.

Students will be able to explain the benefits of having CNC machines: quality improvement, repetition/repeatability, x,y,z controlling at the same time, less wear on tooling, quicker, greater capabilities, run multiple machines at the same time, etc. Moreover, students will be able to explain the negatives of having CNC machines: initial cost, maintenance on machines, educating machinists, size of machines, greater demand on larger orders, etc.

Describe the proper preparation procedures for laying out a workpiece and determining the work tools needed for a situation.

Students will be able to identify that making one thing might make more sense on a manual machine but making 100's makes way more sense on a CNC. Also, manual machines are needed to help create tooling needed for cnc's.

Standards for **(Metals 1)**

MNF1.a.9.h: Select and apply the appropriate units and scales for situations involving measurement.

MNF1.e.8.h: Use a manufacturing system to produce a product.

MNF1.h.8.h: Demonstrate how to use oxy-acetylene and plasma cutting.

MNF1.h.9.h: Compare the pros and cons with plasma cutting and oxy-acetylene cutting manufacturing and analyze cnc cutting operations used in industry.

ENG4.b.5.h: Develop and produce a product or system using a design process.

ENG5.b.8.h: Use computers and calculators to access, retrieve, organize, process, maintain, interpret and evaluate data and information in order to communicate.

Unit 6 - (Machining Techniques)

(Length of Unit - ongoing throughout course)

Throughout the entire class on a daily basis students will be using many pieces of equipment following safety and training. Students will get hands-on experience using lathes, mills, cnc mill, cnc plasma, welders, band saw, chop saw, grinders, drill press, etc. The students will be required to power up, power down, choose the correct speeds and feeds based on material, choose the correct cutters, interchange the cutter throughout the projects, etc. Students might have to heat treat certain parts or projects based on its purpose and function. Students will be working independently and with a partner throughout the course. The students skill-set and talent should improve based on the amount of time given per machine.

In this unit, students will ...

Demonstrate and explain machining techniques and heat treatment.

Students will problem solve and use band saws, spot welders, CNC mill, CNC plasma cutter, metal lathe, vertical milling machine, surface grinder, hand grinders, chop saw, etc. for proper completion of projects.

Students will be able to illustrate and identify various heat-treating concepts: annealing, tempering, case hardening, quenching, and normalizing.

Produce quality products given specific blueprints.

Students will be able to problem-solve and create specific products given material, machine access, blueprints, tolerances, measuring devices, etc.

Demonstrate proper use of cut off saws and drilling machines.

Students will demonstrate proper use of work holding devices, band saws, hack saws, hand drills and drill presses.

Students will change speeds of drill press based on material being cut.

Standards for (Metals 1)

BB1.a.5.h: Describe how systems can fail because of design flaws, defect parts, poorly matched parts or they were used beyond their design capabilities.

BB1.b.5.h: Select appropriate resources and explain how trade-offs between competing values, such as availability, cost, desirability and waste influenced their decision.

MNF1.a.9.h: Select and apply the appropriate units and scales for situations involving measurement.

MNF1.e.8.h: Use a manufacturing system to produce a product.

MNF1.d.6.h: Demonstrate the interchangeability of parts increases the effectiveness of manufacturing processes.

MNF1.h.10.h: Analyze the metallurgical effects heat has on metal during a cutting process or in forming and heat treating.

ENG4.b.5.h: Develop and produce a product or system using a design process.

ENG5.b.8.h: Use computers and calculators to access, retrieve, organize, process, maintain, interpret and evaluate data and information in order to communicate.

