

Materials and Processes

Levels:	Grades
Units of Credit:	
CIP Code:	21.0116
Core Code:	38-01-00-00-073
Prerequisite:	None
Skill Test:	None

COURSE DESCRIPTION

Materials and Processes teaches problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software. In NYS the course is called Design and Drawing for Production and follows the syllabus developed by the State Education Department.

CORE STANDARDS, OBJECTIVES, AND INDICATORS

STANDARD 1

Students will follow safety practices.

Objective 1: Follow general laboratory safety practices.

Objective 2: Follow specific equipment safety practices.

Objective 3: Identify potential safety hazards.

STANDARD 2

Students will utilize precision measurement, gage, and layout tools.

Objective 1: Understand and use measurement tools.

- a. Measure using a rule to the 64th of an inch.
- b. Measure using a micrometer to the .001 of an inch.
- c. Measure using a micrometer to the .01 of a millimeter.
- d. Measure using a dial/digital caliper to the .001 of an inch.
- e. Measure using a universal bevel protractor.
- f. Square a vise using a dial indicator.

Objective 2: Understand and use layout tools.

- a. Layout center lines using a combination square.
- b. Layout center lines using a Vernier height gage.
- c. Locate the origin of a part with an edge finder.

Objective 3: Understand and use gages.

- a. Calibrate micrometers using gage standards.
- b. Compare measurements using gage blocks and a dial indicator.

STANDARD 3

Students will understand the nature and properties of materials.

Objective 1: Explain the atomic structure of materials.

Objective 2: Identify materials.

Objective 3: Describe physical properties.

Objective 4: Describe mechanical properties.

STANDARD 4

Students will utilize manufacturing processes.

Objective 1: Understand and use the various casting and molding processes.

- a. Sand cast an aluminum part.
- b. Investment cast a metal part.
- c. Injection mold a plastic part.
- d. Rotational mold a plastic part.
- e. Vacuum mold a plastic part.
- f. Mold an expandable polystyrene part.
- g. Lay-up a composite.

Objective 2: Understand and use the various forming processes.

- a. Hot form a steel part.
- b. Cold form sheet metal.
- c. Form a part using powder metallurgy.

Objective 3: Understand and use the separating processes.

- a. Drill a hole.
- b. Ream a hole.
- c. Bore a hole.
- d. Mill a part.
- e. Turn a part.
- f. Saw a part.
- g. Grind a part.
- h. Broach a keyway.
- i. Counter bore and countersink a hole.
- j. Tap internal threads.
- k. Cut external threads using a die.
- l. Chamfer and deburr a part.
- m. Shear a part.
- n. Saw a board (wood).
- o. Plane a board (wood).
- p. Joint the edge of a board (wood).
- q. Shape the edge of a board (wood) using a router.

Objective 4: Understand and use Computer-Numerical Control (CNC).

- a. Operate a CNC mill.
- b. Set-up a CNC mill.
- c. Write a CNC milling program using G & M codes.
- d. Write a CNC milling program using CAD/CAM.
- e. Rapid prototype a part from a 3D parametric model.

Objective 5: Understand and use various fastening and joining methods.

- a. Solder electronic components and other materials.
- b. Weld parts.
- c. Braze parts.
- d. Adhere (glue) parts.
- e. Utilize threaded fasteners.
- f. Rivet parts.

Objective 6: Understand and use various finishing methods.

- a. Abrasive clean parts.
- b. Media blast parts.
- c. Tumble and vibrate parts.
- d. Brush and spray finishes.
- e. Plate and anodize parts.

Objective 7: Understand and use various conditioning processes.

- a. Harden steel.
- b. Temper steel.
- c. Anneal steel.
- d. Temper aluminum.
- e. Dry materials.
- f. Chemically condition materials.

STANDARD 5

Students will understand the principles of quality control.

Objective 1: Understand and test using the Classical Process Control.

- a. Explain various inspection methods and testing operations.
- b. Inspect using a go/no-go gage.
- c. Inspect surface finish.
- d. Test for hardness.
- e. Test for tensile strength.

Objective 2: Understand and use the Statistical Process Control (SPC).

- a. Calculate the mean and standard deviation of a sample or population.
- b. Interpret normal distribution data.

STANDARD 6

Students will use, design and fabricate tooling.

Objective 1: Understand and use cutting tool geometry.

- a. Explain tool geometry.
- b. Grind lathe tool (single point).
- c. Grind a drill bit (multi-point).
- d. Select cutting tool inserts and assemble tooling.

Objective 2: Understand, design, and use jigs and fixtures.

- a. Explain location methods used in jig and fixture design.
- b. Classify and explain uses for various jigs and fixtures.
- c. Categorize and explain uses for clamping methods.
- d. Design and construct jigs and fixtures.

Objective 3: Describe the various precision holding devices.

- a. Describe various vises and how they are used.
- b. Describe collets and how they are used.
- c. Describe mandrels and how they are used.

Objective 4: Design, build, and test prototypes.

- a. Design a project.
- b. Establish performance and testing parameters.
- c. Create a Gantt chart.
- d. Generate a cost and resource analysis.
- e. Build and document the fabrication process.
- f. Test against established parameters.