UR East Overview of Year

10th/11th Grade Precision Optical Fabrication Curriculum

SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE
Unit 1 Introduction to Machining Brittle Materials			**Unit 2** Machining Brittle Materials		**Unit 3** Verification & Interferometry			**Unit 4** Advanced Production Methods	

Precision Optical Fabrication at East High:

Students are introduced to the nature of light, glass, and the interplay between the two. Science and engineering content is embedded throughout the year as students learn the fundamentals of advanced manufacturing processes. Students develop habits of mind and skills necessary to manufacture a finished good based on customer specifications.

Specific to precision optics, students learn how to machine, grind, polish and verify precision lenses, flats, and prisms. The finished optical elements are suitable for use in telescopes, microscopes, cameras, and other commercial imaging devices. Students use equipment, machines, and tools identical to those found in Rochester's thriving optical fabrication industry. Skills developed and practiced in this class can give students direct entry into the workforce after graduation or entrance to Monroe Community College's and the University of Rochester's optics programs.

Key skills include maintaining a safe and clean work area, precision metrology, and blueprint design. Students get experience operating a Blanchard Grinder, a Rogers & Clarke Curve Generator, a Centering (edging) machine, bench top grinders, spindle polishers, and a planetary polisher. Students will use test plates for rough verification. Students will use a zygo interferometer and software for final verification of final parts.

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Unit I Overview – Introduction to Machining Brittle Materials: Students are introduced to the nature of light, glass, and the interplay between the two. While science and engineering content is shared, students also start to develop habits of mind necessary to manufacture a finished good based on customer specifications.

This unit starts the year with a balance of information specific to optics and process information and skills that can be transferred to any advanced manufacturing industry or field of engineering.

Unit 1-	Understanding	Essential Question
CDOS Standards (Career Development and Occupational Studies): 1, 2, 3a, and 3b	Enduring Understandings *Scholars will understand that…* 1. Optical components are made from a variety of materials; each material has benefits and liabilities. 2. A 2-D model (blueprint) is constructed before anything is manufactured. 3. Measuring is an essential part of manufacturing.	Essential Questions *Scholars will consider such questions as…* 1. What happens when light reaches an air-glass boundary? 2. Why does the shape and composition of an optic determine its function? 3. How do I know which optical glass to use? 4. How precisely can we measure that?
Performance Task: Students will interpret a customer's product desires and demands and construct a full blueprint for an optical component from this. In general terms, students will integrate technical skills and knowledge to create a model for production based upon customer specifications.		
Formative Assessments: Career Pathways programs will monitor universal employability skills for each student. These will be formally assessed with our school Employability Profile.		

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Unit II Overview – Machining Brittle Materials: Students enter the manufacturing space in this unit. The first order of business is establishing safe practices and habits. Then, students rotate through three different manufacturing processes that introduce specific precision optics machines and processes.

Science and engineering content is infused in the unit but there is special emphasis on applications of math to a production process. Students get their initial exposure to many elements of a multi-step advanced manufacturing process.

Unit 2-	Understanding	Essential Question
CDOS Standards (Career Development and Occupational Studies): 1, 2, 3a, and 3b **CCTE (Common Career Technical Core)** 1, 2, 8, 10	Enduring Understandings *Scholars will understand that…* 1. productive and profitable workplaces pay close attention to employee safety and logical workflow. 2. it is important to measure and verify a part throughout a manufacturing process. 3. mathematics is an essential tool that is used to efficiently machine precision parts.	Essential Questions *Scholars will consider such questions as…* 1. What makes a safe workplace? 2. How do I know when to move to the next step in the process? 3. How is mathematics used to make accurate and reliable predictions?
Performance Task: Students will machine, grind, polish, and verify a plano and spherical optical component according to blueprint specifications. Each part is made through a multi-step production process. The spherical process gives students experience operating a curve generator, using a loose abrasive benchtop grinder, and working with a spindle polisher. The plano process gives students experience operating a Blanchard grinder, using a fixed abrasive grinder, waxing parts, and running a continuous planetary polisher. Throughout both processes, students use precision tools to verify part dimensions.		
Formative Assessments: Career Pathways programs will monitor universal employability skills for each student. These will be formally assessed with our school's Employability Profile.		

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Unit III Overview – Verification & Interferometry: Students will take their parts through the production process and learn how to use advanced techniques and technology to measure lens and plano optics according to industry standards.

Unit 3-	Understanding	Essential Question
CDOS Standards (Career Development and Occupational Studies): 1, 2, 3a, and 3b **CCTE (Common Career Technical Core):** 1, 2, 8, 10	Enduring Understandings *Scholars will understand that…* 1. You can only manufacture a part to the precision that you can measure the part. 2. Interferometers are complex optical systems that are used throughout industry to verify the precision of parts. 3.	Essential Questions *Scholars will consider such questions as…* 1. How can I prove the precision of my part? 2. When do I have to be most precise in the process? 3.
Performance Task: Students will take "before" and "after" interferograms of a test plate that demonstrates how adjustments to the polishing stroke improves the surface quality.		
Formative Assessments: Career Pathways programs will monitor universal employability skills for each student. These will be formally assessed with our school's Employability Profile.		

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Unit 4 -	Understanding	Essential Question
CDOS Standards (Career Development and Occupational Studies): 1, 2, 3a, and 3b **CCTE (Common Career Technical Core):** 1, 2, 8, 10	Enduring Understandings *Scholars will understand that…* 1. small adjustments at different stages of production can have large rippling effects on the final product. 2. technical communication is learned and must be practiced to be effective.	Essential Questions *Scholars will consider such questions as…* 1. What happens when a production variable is changed? 2. Why is it important to analytically analyze a production process?
Performance Task: Students will manufacture an optical loupe. This loupe is constructed from two lenses that are aligned and precisely assembled in a custom housing. Students will continue to refine the lens manufacturing process and gain experience handling lenses and setting them in place in a finished optical system.		
Formative Assessments: Career Pathways programs will monitor universal employability skills for each student. These will be formally assessed with our school's Employability Profile.		

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Unit 4-	Understanding	Essential Question
	Enduring Understandings *Scholars will understand that…*	Essential Questions *Scholars will consider such questions as…*
Performance Task:		
Formative Assessments:		

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Unit 5-	Understanding	Essential Question
	Enduring Understandings *Scholars will understand that…*	Essential Questions *Scholars will consider such questions as…*
Performance Task:		
Formative Assessments:		

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Unit 6-	Understanding	Essential Question
	Enduring Understandings *Scholars will understand that…*	Essential Questions *Scholars will consider such questions as…*
Performance Task:		
Formative Assessments:		