Subject: Precision Optics Grade: 10-11 Unit #: 1 Title: Introduction to Machining Brittle Materials

UNIT OVERVIEW: 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.

STAGE ONE: Identify Desired Results

Established Goals/Standards

Established Goals (CDOS)

Standard 1 **(TP)**: Students will be knowledgeable about the world of work and relate personal skills, aptitude and abilities to ***set short term goals*** and to ***work collaboratively.*** .

Standard 2: Students will demonstrate how academic knowledge and skills are applied in workplace and other settings ***to solve problems and make decisions***.

Standard 3a: Students will ***take risks and learn from mistakes*** in order to demonstrate mastery of the foundation skills and competencies essential for success in the workplace.

Standard 3b: Students ***will access resources necessary to*** acquire the career specific technical knowledge/skills to progress toward gainful employment,

Long-Term Transfer Goal

At the end of this unit, students will use what they have learned to independently… integrate technical skills and knowledge to create a model of production that shows part dimensions and tolerances at various points in the production process.

Meaning

Enduring Understandings

Students will understand that…

- Optical manufacturing is important to the City of Rochester and the U.S.
- Lenses and prisms are made from a variety of materials; each material has benefits and liabilities.
- Measuring is an essential part of any manufacturing process; precision manufacturing utilizes microscopic levels of measure.
- A 2-D model (blueprint) is the pre-determined plan that provides specific criteria and tolerances that a finished product must meet.

Essential Questions

Scholars will consider such questions as…

1. *Why is the only Precision Optics program in the U.S. at East High?*
2. What happens when light reaches an air-glass boundary?
3. How precisely can we measure that?
4. What can we 'get away with' at each point in the process?

Acquisition

What knowledge will students learn as part of this unit?

- *The Greater Rochester area has over 3,000 jobs and more than $3,000,000,000 in sales in optics.*
- *Glass is a family of brittle materials; each type has specific physical (optical) properties.*
- *The Electromagnetic Spectrum is the array of photon types organized by wavelength and energy.*
- *Aluminum oxide particles (grit) can be controlled, by size, to control the extent of subsurface damage due to the loose abrasive grinding process.*
- *Principles of Geometry are essential to design a finished product.*
- *There is a small set of dimensions needed to adequately describe a lens.*

What skills will students learn as part of this unit?

- Interpret glass codes and glass maps.
- Use micrometers, calipers, and rulers to measure part thickness and diameter.
- Use spherometers to measure the sagitta (sag) of a lens across a certain diameter.
- Handle polished objects without scratching the surface.
- Draw precise shapes from given dimensions using a compass, ruler, and protractor.
- Illustrate a divot and subsurface damage

	career advancement and success in postsecondary programs.	• *A tolerance is a range, within a set of parameters, that a product or part is manufactured to meet.* • *Larger grit particles have a faster removal rate and leave more sever subsurface damage*	• Use 12 T grit to create a 150 micron divot on a plano surface. • Through loose-abrasive grinding, remove glass from the surface of a lens to achieve a common surface suitable for the polishing process. • Use a bench top grinder and plano tool to create a 1.5 mm bevel. • Use of a scale loupe to measure bevels and nibs.

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STAGE TWO: Determine Acceptable Evidence	
Evaluative Criteria	**Assessment Evidence**
Criteria for success: - Explanation – Can they explain the manufacturing process? - Interpretation – Can they illustrate the process and teach someone else? - Application – Industry work - Perspective – Why we are decreasing sub-surface damage? - Empathy - Self-Knowledge	Performance Tasks: **Goal:** Your goal is **to** train a new hire on the process of taking a lens blank with a plano surface to a curved surface that is suitable for polishing. **Role:** You are a trained worker at Optimax Systems, Inc. **Audience:** The audience is an apprentice that is learning the manufacturing process. **Situation:** You have been tasked with creating a step by step manual, with illustrations and explanations, to train your apprentice on the manufacturing process and preparing a spherical piece of lens for polishing. **Product Performance and Purpose:** You need to determine the key steps pf the manufacturing process, creating illustrations for each step. You should include an overview of the process you take to get from one illustration to the next and explain the importance of each process you carry-out. Include information on sub-surface damage and the key factor it plays in preparing a machined part for polishing. **Standards and Criteria for Success:** Your machining glass manual **needs to include** - A minimum of six illustrations of the manufacturing process going from a plano surface to a generated curve suitable for polishing - An explanation of the procedures involved to get from one step to the next - An explanation of the loose abrasive grinding process and the connection with sub-surface damage - The process of creating a divot, its depth, and the importance of doing so - The rationale behind using 20t grit and then 12t grit - A list of the tools and instruments needed to perform each step of the process

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	Other Assesment evidence: - Vocab quizzes - Measuring with tolerances - Loose-abrasive grinding illustrations

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Code	STAGE THREE: Plan Learning Experiences	
	Learning Events:	Evidence of learning: *(formative assessment)*
A	1. Hook: How do we craft a PRECISE optic? Why is precision important in our field?	
A/T	2. Hubble Telescope documentary – Proof that precision is vital in the manufacturing of optics	1. Hubble worksheet
M	3. Lens rail activity – candle image clarity	2. Lens rail meaning making activity
A	4. Comparing and contrasting two optical glass types and their properties.	3. Glass type worksheet
A	5. Measuring glass blocks with rulers, calipers, and micrometers.	4. Measure precisely activity
A/M	6. Measuring gauge blocks with calipers and micrometers.	5. Terminology quiz
A/M	7. Learning to sketch, freehand, simple 2-D and 3-D geometric shapes.	6. Competently sketch simple shapes and figures.
A	8. Learning to sketch simple 2-D and 3-D shapes with rulers, compasses, and protractors.	7. Competently construct precise shapes and figures.
A	9. Measuring sagitta (sag) of lenses, edge thickness, and center thickness.	8. Sag activity
T/M	10. Grinding with 30t, 20t, 12t – Removal rate	9. Grit/sub-surface damage illustration activity
T/M	11. Grit types and the grinding process – Sand paper activity	
	12. What is sub-surface damage and how do we control its severity?	