OVERVIEW AND PRESENTATION FLOW

• Glossary and Important Terms
• EO Microscopy Product Line and Offering
• Choosing an Objective
• Transmission Objective Overview
• Setting Up a Simple System
• Reflective Objectives
• Mounting and Tube Lengths
GLOSSARY AND IMPORTANT TERMS

• **Numerical Aperture** – function of the focal length and entrance pupil diameter

• **Oil Immersion** – medium used on objectives with an NA higher than 0.95
  – Examples: Air, water, glycerin, paraffin oil, synthetic oil, anisole, bromonaphthalene
  – Indices of refraction ranging between 1.01 – 1.65

• **Working Distance** – Distance between the surface of the specimen and the front face of the objective when in focus
  – LWD, ELWD, SLWD, ULWD

• **Field of View** – the size of the image formed by the lens on to the sensor
EDMUND OPTICS PRODUCT OFFERING

- Infinity Corrected Objectives
- Finite Conjugate Objectives
- Reflective Objectives
- Stereo Microscopes
- Miscellaneous
  - Accessories, eyepieces, relay lenses, couplers, reticles, micrometers, pocket and direct microscopes, simple magnifiers
TRANSMISSION OBJECTIVE SPECS

Typical color code for magnifications

<table>
<thead>
<tr>
<th>Magnification</th>
<th>1X</th>
<th>2X</th>
<th>3X</th>
<th>4X</th>
<th>10X</th>
<th>20X</th>
<th>40X</th>
<th>60X</th>
<th>100X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Code</td>
<td>Black</td>
<td>Gray</td>
<td>Red</td>
<td>Yellow</td>
<td>Green</td>
<td>Light Blue</td>
<td>Light Blue</td>
<td>Dark Blue</td>
<td>White</td>
</tr>
</tbody>
</table>

EO

Proprietary - Property of Edmund Optics, Inc. | 2011 Copyright© Edmund Optics, Inc.
HOW TO CHOOSE THE RIGHT OBJECTIVE

- **Achromatic** ~ 3-5 lens elements
- **Fluorite** ~ 5-9 lens elements
- **Apochromatic** ~ 9-18 lens elements

**Achromatic** – corrected for chromatic aberration at the red and blue wavelengths only

**Apochromatic** – corrected for chromatic aberration at the red, blue, and yellow wavelengths

**Fluorite** – to be used in low light level detection, specifically fluorescence emission

**Plan** – objective lens that produces a flat (planar) image by correcting the spherical aberration/curvature of the field of an achromatic/apochromatic lens
FINITE CONJUGATE OBJECTIVES

• Light from a source is focused (not from infinity)
• Characterized by DIN or JIS standards
• Utilized when cost and ease of design are concerns
  – Offer little to no filtering or in-line illumination
  – No tube lens required for focus
  – Account for majority of basic microscope systems where only simple magnification and lighting is required
INFINITY CORRECTED OBJECTIVES

• Offer longer working distances
  – Allows for larger samples, elaborate mechanics, and room to operate (dyes, reagents, catalysts)

• Allow for addition of in-line components
  – Filters, beamsplitters, and mechanics

• Light rays focused with assistance of secondary/tube lenses
  – Set at specific, long distance from objective (~160-200mm)

• Enable in-line illumination
  – Improved lighting and convenient for space constraints
INFINITY CORRECTED OBJECTIVES

• In-line filtering/illumination assembly
  – More complex and detailed system

• Direct video assembly
  – Simple, direct approach for basic imaging
INFINITY CORRECTED OBJECTIVES
INFINITY CORRECTED OBJECTIVES

[Diagram of optical equipment setup with labels for each component including C-Mount Camera, 190mm Extension Tube, MT-1/MT-2 C-Mount Adapter #58-329, MT-1 Tube Lens #54-774, MT-2 Tube Lens #56-863, 57mm of Extension Tubes for Best Image, Mitutoyo C-Mount Adapter #55-743, and Objective.]
REFLECTIVE OBJECTIVES

• Two mirror, Schwarzschild reflective objective type

• Reflective vs. Refractive
  – Reflective provides chromatic correction over broad spectral ranges
  – Reflective offers variety of coating options for deep UV, IR, and laser line performance

• Important Specifications
  – Transmitted Wavefront Error - difference between the wavefront from when it enters and exits the system
  – Obscuration - central portion of primary mirror that does not transfer rays

• Edmund Optics offers TECHSPEC® ReflX™ Objectives
REFLECTIVE OBJECTIVES

• **Infinity corrected** – Ideal for focusing applications
  – Focusing broadband or multiple laser source to a single point
• **Finite conjugate** – Ideal for imaging applications
  – Excellent resolution - no additional focus elements needed
  – Interchangeable with standard microscope objectives
MOUNTING THREADS AND TUBE LENGTHS

• Royal Microscopy Society (RMS) - 0.8” x 36TPI, Whitworth
  – Society Thread
  – ~200mm tube length

• Deutsches Insititut fur Normung (DIN) - 0.7965”, 36TPI, 55` Whitworth
  – 45mm standard objectives
  – 160mm tube length
  – Object to image distance 195mm, fix object distance at 45mm, and remaining 150mm for internal
    real image position (10mm from end of tube)

• Japanese Industrial Standards (JIS) - 0.7965”, 36TPI, 55` Whitworth
  – 36mm standard objectives
  – 170mm tube length
  – Rare cases have slight variation on Parfocal Distance and Tube Length

Typical Objective Manufacturer Specifications

• Mitutoyo Standards - 26mm x 0.706mm pitch (36 TPI), 200mm tube lens focal length, 95mm parfocal distance
• Olympus Standards - RMS thread type, 180mm tube lens focal length, 45mm parfocal distance
• Nikon Standards - M25 thread type, 200mm tube lens focal length, 60mm parfocal distance
• Zeiss Standards - RMS thread type, 165mm tube lens focal length, 45mm parfocal distance