Eye fatigue, dioptre control and astigmatism correction.

1. Correct eyepiece setting and dioptre control

If a compound microscope or stereo-microscope, is used for any length of time without proper adjustment, eye fatigue and soreness can easily occur, as your eye muscles continually work against a poorly-adjusted instrument as your eye scans the image. If you are beginning in microscopy, do not tense up your eyes: you are not required to try and set your eyes for near vision merely because you want to see something small – as you would without any optical aid. First of all, look into the distance with relaxed vision, and then look into the eyepieces and adjust the inerpupillary distance until you see one circle instead of two. Consciously use both your relaxed eyes for viewing.

When a normal healthy eye is observing a microscope image it will *accommodate* -i.e. adjust the strength of its lens as it does when it focuses on objects at different distances. This enables the eye to see clearly features which are imaged slightly above or below the normal primary image plane. Combined with small movements of the fine-focus control, this permits three-dimensional or unflat objects to be studied without discomfort. It should be noted here that one of the very few advantages of increasing years is that one becomes better able to focus low-power micrographs as presbyopia removes the power of accommodation.

Users frequently blame the microscope when it fails to maintain focus throughout its range, not understanding that a simple user adjustment is required. It is a fundamental and crucial procedure, but one that appears to be rarely taught.

For the **conventional compound microscope** the procedure is:

1. Set microscope up carefully using a fine-detailed specimen, and change to the highest dry objective.
2. Set interocular distance on binocular head (if fitted) for comfortable use.
3. Focus precisely using the fine focus adjustment.
4. Change to lowest magnification objective but **do not** readjust microscope focus controls.
5. Focus image for each eye by using the individual adjustment for each eyepiece.
6. Repeat steps 1. to 5., and the microscope should then maintain focus throughout its magnification range.

Where a microscope of either type is fitted with one or more eyepieces with built-in focusing adjustments for a photographic frame or a graticule, these should ideally be used in eyepiece tubes of adjustable length, and should be set before step 4. is carried out. For correct adjustment, microscopes having eyepiece tubes of fixed length should always be fitted with a pair of eyepieces with focusing adjustments.

Use the white fiducial mark if there is no measuring graticule fitted to the eyepiece; use the red fiducial mark as a zero point if there is a graticule inserted within the eyepiece.

Modern eyepieces are generally ‘high eyepoint’, meaning that the Ramsden disc, or exit pupil of the microscope, is situated several millimeters above the top lens of the eyepiece.

2. Spherical aberration & Astigmatism

The rubber cups on the eyepieces are designed to help keep your eyes at the correct height. If you slowly move your head to and fro in front of the eyepieces, you will soon find the optimum height and relaxed posture to allow you to see the entire single circle of the field of view. Often the eyepiece will signify that it is a high-eyepoint type with a little icon of a pair of spectacles, to indicate that these eyepieces may be used easily and comfortably by spectacle wearers. The question arises: do I have a choice whether to use my spectacles (as part of the imaging system), or not?

Spectacle wearers whose glasses have lens with a spherical power for correction of long-sight (hypermetropia – positive dioptres) or short-sight (myopia – negative dioptres) can use the microscope with or without their glasses, providing, the range of the dioptre setting is sufficient. If you require lenses with a toric power, that diffract light differently in the horizontal from the vertical position, then your eye(s) have non-symmetrical astigmatic aberrations which cannot be compensated for by dioptre setting alone. To test this: hold your spectacles at arm’s length and view a simple geometric image (eg a circle or square) through each lens in turn. Rotate each lens about about the x-y axis in one plane, first horizontally then vertically. If the image appears expanded or compressed by this rotation, then your eyes are astigmatic, and you should wear your spectacles when viewing any image through the microscope.