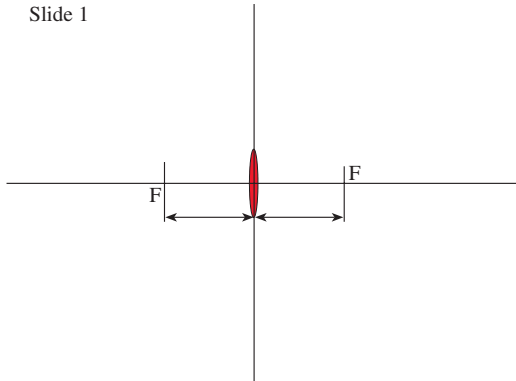
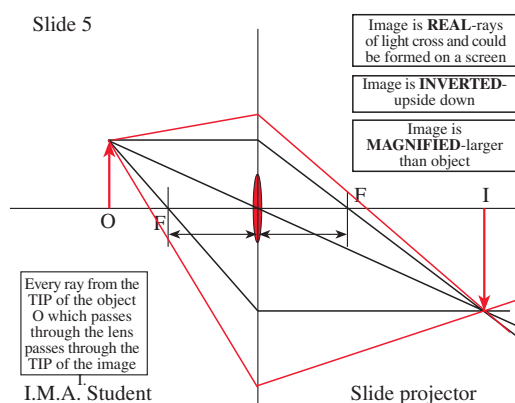
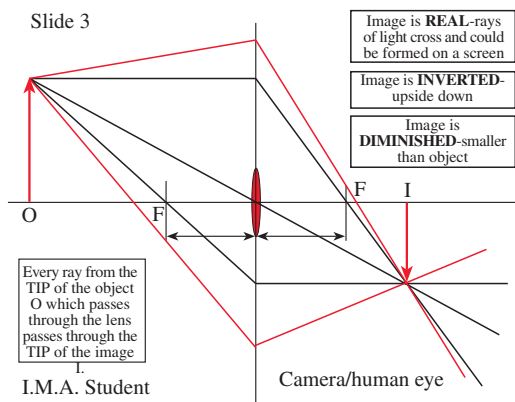
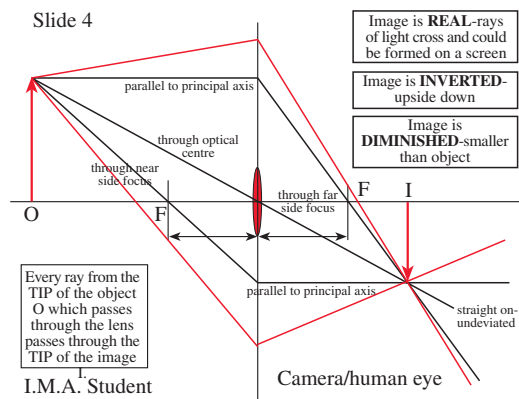
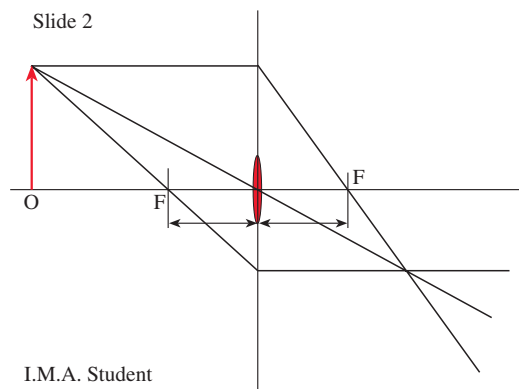


Lens diagrams and PowerPoint

The line drawing and animation facilities in PowerPoint and its ready availability make it a useful tool for students to use to generate interest and comprehension of lens diagrams. I find the following sequence works well; it is no more than a ray drawing program would do and serves as an introduction to the students drawing the ray diagrams by hand. The student brief is to produce an animated slide that demonstrates the sequence required to locate an image position for an object with a converging lens. The role reversal of learner as teacher has many

Slide 1





positive aspects, mainly that a good understanding of the method is required before knowledge is cascaded. The task operates with an 'in-house' program 'lensrays' to review the sequencing and extend it. This program is available from the author on request.

Step 1. I provide a template PowerPoint of a lens shape, positioned centre screen. The vertical on which the lens is located is taken as the lens; the symbol indicates only the lens type, not the extent of the lens. Included are the principal axis and the lens axis and two arrows indicating the (equal) focal lengths. Able students should be able to construct this template without problems using the copy and paste facility to ensure that the focal lengths are **exactly** equal and shifting the lens shape by small amounts if necessary using the control key in combination with the arrow keys. (Slide 1)

Step 2. Student name on slide. A large upright arrow is placed at the left edge of the slide by accessing the View...Toolbars...Drawing..... arrow option. Adjust the attributes of the arrow with appropriate colour/width and pointer. This

is the object (label O).

Step 3. The 'standard' rays are drawn in turn from the tip of the object, following the rules.....

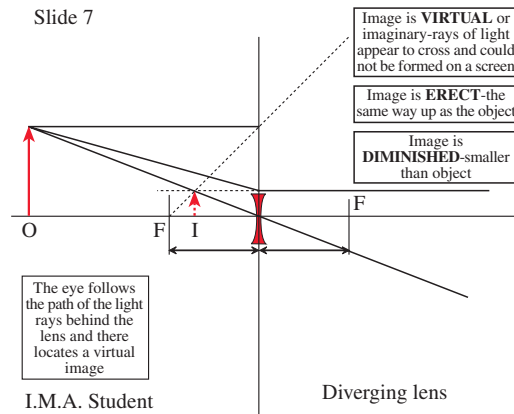
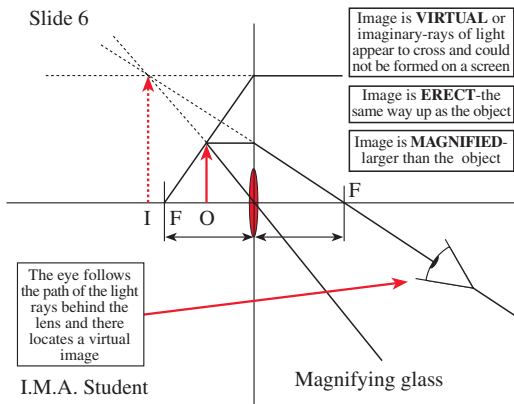
- parallel to principal axis—through the focus on the far side
- through the optical centre—straight on
- through the focus on the near side—emerges parallel to the principal axis.

The third ray acts as a 'check' ray to confirm the correct location of the image tip. The emerging rays should cross on the right hand side of the slide. (Slide 2)

Step 4. The image is drawn in as an inverted arrow (label I) and described in a suitably positioned text box as Real, Inverted and Diminished. Some extra rays can be drawn (in another colour so as not to detract from the important standard rays) to show that every ray from the tip of the object which passes through the lens goes through the tip of the image. Use.....camera and eye lens. (Slide 3)

Step 5. The student animates the slide, takes a

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copy for his notes and saves it in his revision folder. Animation is done in PowerPoint by accessing the Custom Animation sub-menu from the Slide Show menu and choosing appropriate ordering of the slide components and animations. I have added labels to the rays to describe the behaviour when it strikes the lens. (Slide 4)

Step 6. From template start with a smaller object about $1.5f$ from the lens to produce a real, inverted and magnified image. Useslide projector. (Slide 5)

Step 7. From the template start with a smaller object about $0.5f$ from the lens to produce a virtual, erect and magnified image. Use....magnifying glass. (Slide 6)

Step 8. Diverging lens. (Slide 7)

The benefits

In an examination situation both at GCSE and at A-level the students are expected to draw accurately by hand. After use of the PowerPoint method, the precision in the hand-drawn versions was much greater than before—no enormous error triangles in the tip location; something had been absorbed about the precision level from the computer drawing. Teachers without multiple computer facilities may wish to operate the slides as a sequential demonstration of the method.

The Powerpoint file is available in the electronic version of the journal or directly from the author.

J G Evans

King Edward's School, Birmingham, UK
jake@kes.bham.sch.uk