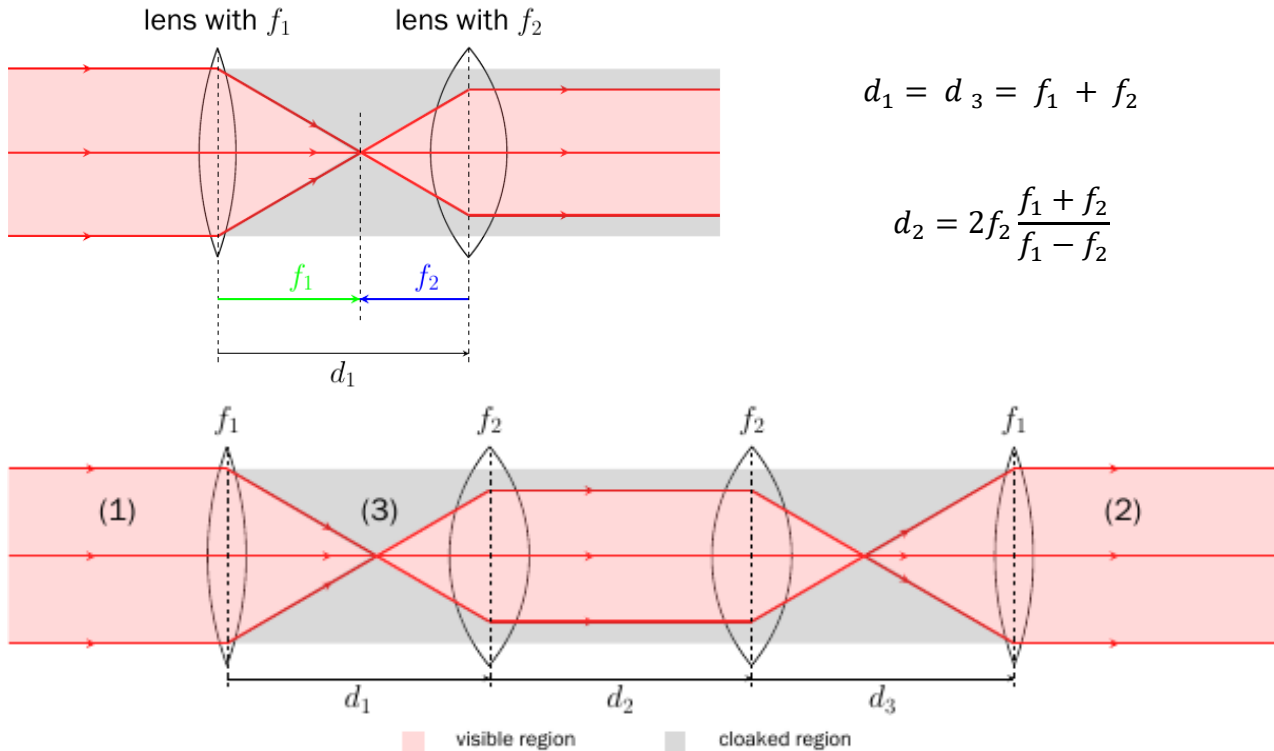


Activity: Building a Rochester Cloak

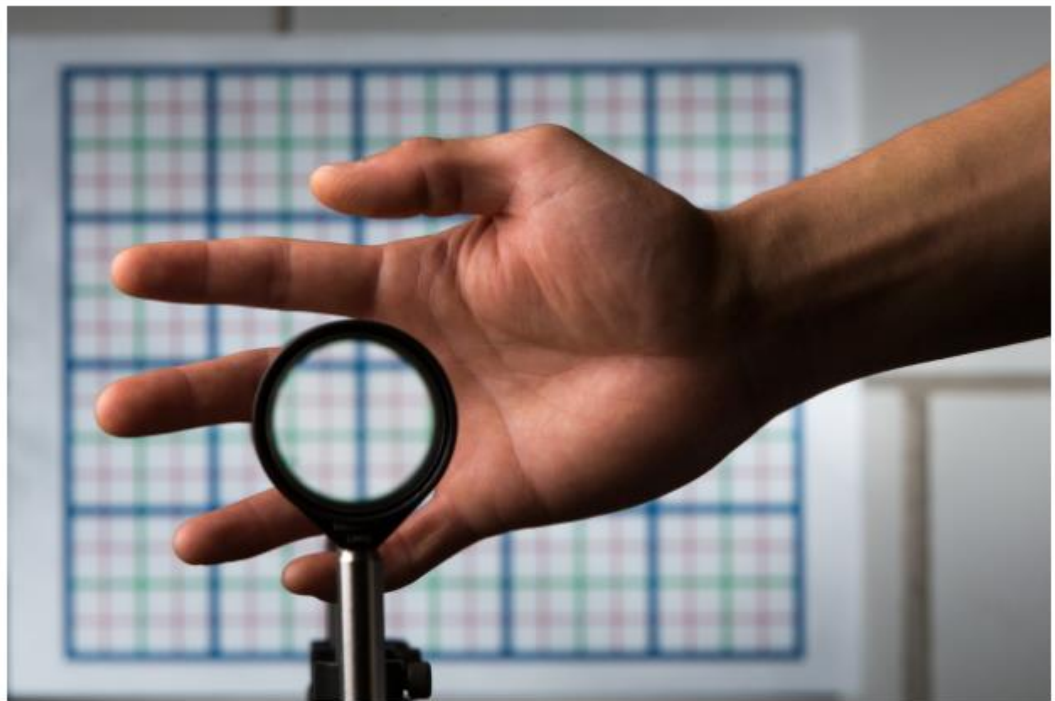
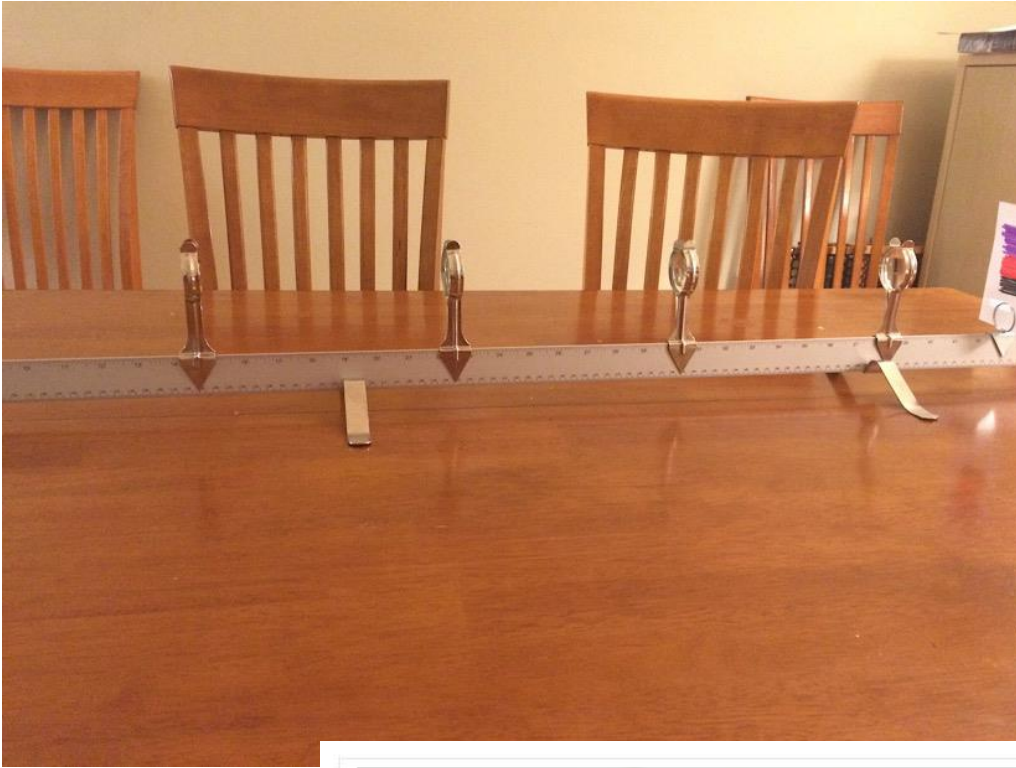
Calculate the distance between lenses:

- Step 1: Calculate the distance between lenses 1 & 2 ($d_1=d_3$).
- Step 2: Calculate the distance between lenses 3 & 4 (d_2)



Building the Cloak

- Step 1: Place the lenses in the lens holder. Make sure to keep track of the focal lengths! (hint: thicker lens= shorter fl)
- Step 2: Secure the optic bench supports to the meter stick and make sure it is level.
- Step 3: Place the first f_1 lens at the zero mark of the meter stick.
- Step 4: Place the remaining lenses according to your calculations. Make sure the lenses are aligned straight!
- Step 5: Create a background design on your notecard. Place in optic bench screen holder and place at the end of your meter stick behind lenses.
- Step 6: Use the laser pointer to check your alignment. The beam should emerge through all lenses unchanged (no bigger or blurrier)
- Step 7: Stand back and look down the lenses to make sure your background is clear.
- Step 8: Explore the cloaked areas with your partners!



A multidirectional "perfect paraxial" cloak using four lenses. From a continuous range of viewing angles, the hand remains cloaked, and the grids seen through the device match the background on the wall (about 2 m away), in color, spacing, shifts, and magnification. // photo by J. Adam Fenster / University of Rochester

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Lizzie Hager-Barnard, The NISE Network; <https://www.rochester.edu/newscenter/watch-rochester-cloak-uses-ordinary-lenses-to-hide-objects-across-continuous-range-of-angles-70592/>; <https://interestingengineering.com/build-own-cloaking-device>