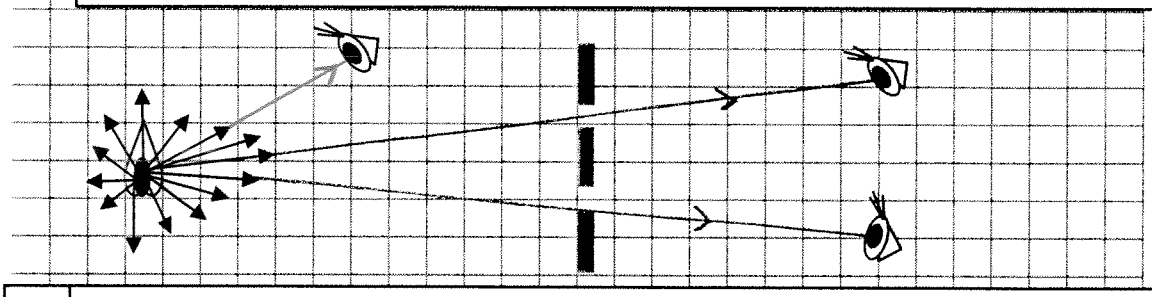
SNC 2DI

Name: ANSWERS

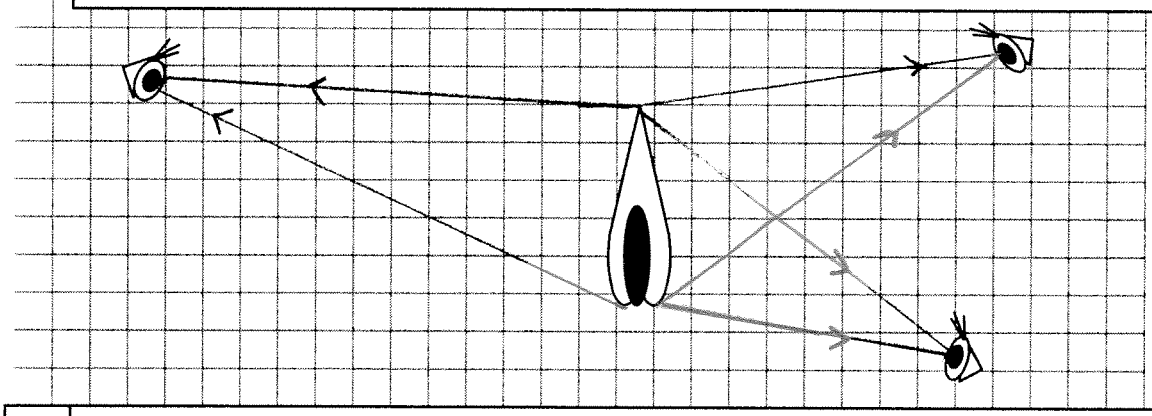
Introduction to Ray Diagrams: Worksheet

How can we draw rays in a way that will be quick, easy, and helpful for learning about light?

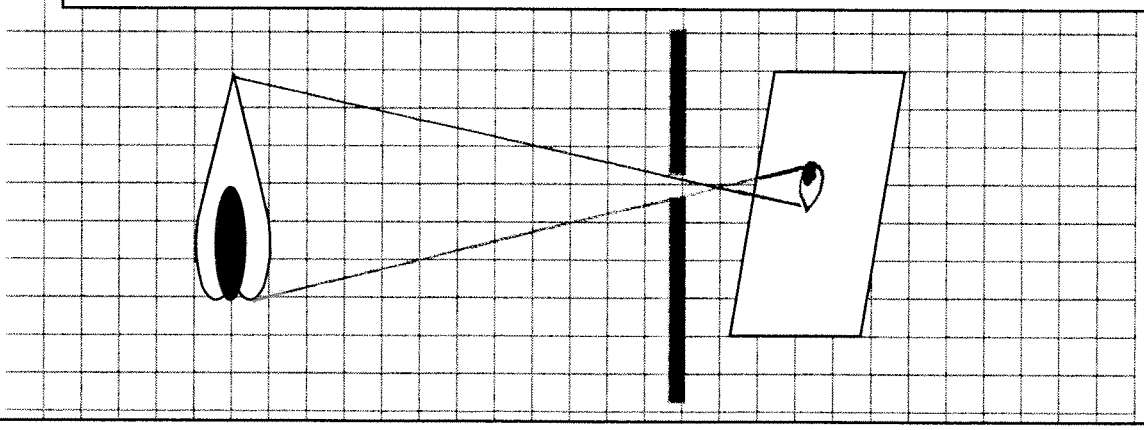
A *Light rays leave luminescent objects in all directions and travel in straight lines. Out of the infinite number of rays that leave an object, only very few of them are helpful so let's get used to only drawing those ones!* Which of the rays below will reach the eyes of the observers?



B *Light rays don't really just leave the centre or the top of an object. If the whole object is luminescent, or if the whole thing is lit up and reflecting light, then light rays will leave from all sides in all directions. But that again would be way too many rays to draw. So let's agree to just draw the rays from the top and bottom of objects, since the other rays will be similar.* Draw <u>only</u> the top and bottom rays of the flame that make it to the observer's eyes below:



C Using the same principle as above, draw <u>only</u> the top and bottom rays of the flame that make it to the screen behind the tiny hole:



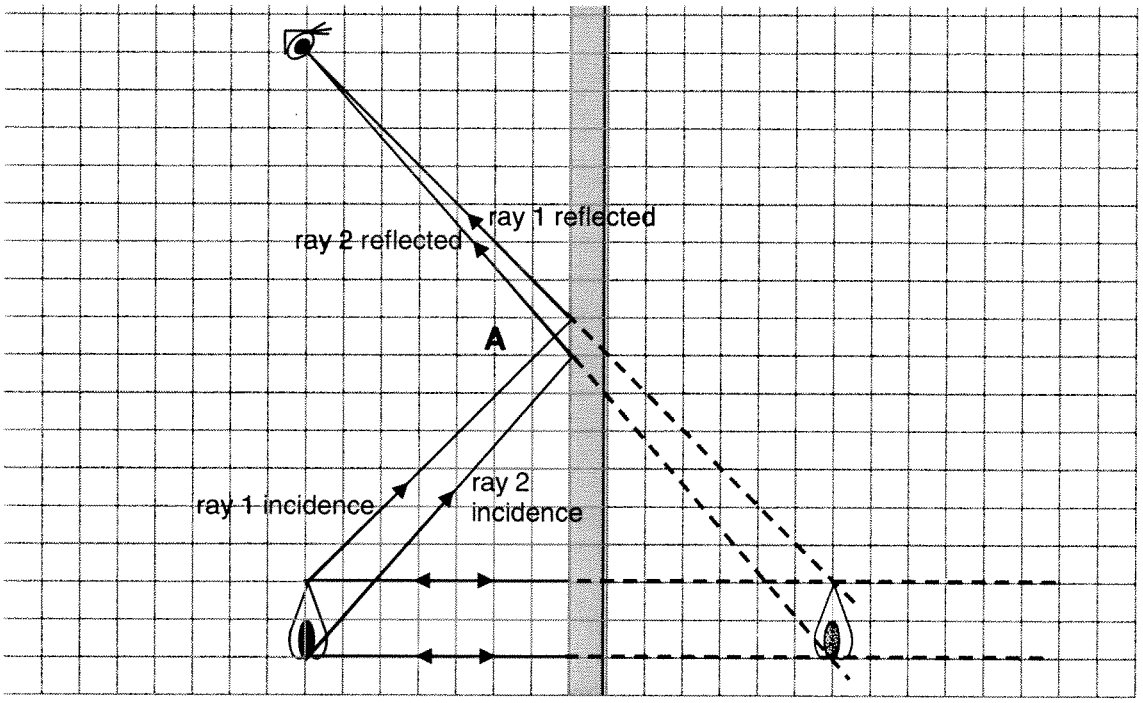
If it worked out for you, the image is upside down! This is the basic design of a "pinhole camera"; and it is how our eyes work. Indeed, the images that form on our retina are upside down, but our brains automatically flip them over for us!

SNC 2DI

Name: ANSWERS

Flat Mirror Worksheet A

Why is it that when you see something in a plane mirror, it looks like you're actually looking at an object behind that mirror? Why does it look further away than the mirror itself is?



1. Draw a ray from the tip of the flame up at a diagonal so that it hits the mirror at 45°, near point A. (You can cheat to get the 45° angle by perfectly cutting the grid lines diagonally in half.)
2. Using the mirror reflection rule, draw the reflected ray as well. Extend it to the observer's eye. Let's call this entire ray from the flame to the eye "ray 1". Label it on your diagram.
3. Do you believe that a ray leaving the bottom of the flame and reflecting to the observer's eye as well, will strike the mirror one square lower than ray 1 did? (Check it out if you don't believe it: hitting two squares lower will make the reflected ray go under and miss the eye!)
4. Whether you believe it or not, draw in the ray from the bottom of the flame, to one square below the reflection point of ray 1, and extend it to the eye. Label this "ray 2".
5. Label "ray 1 incidence", "ray 1 reflected", "ray 2 incidence", and "ray 2 reflected".
6. If you have overhead (OH) sheets and dry erase markers, line up the OH edge to the mirror so that you can trace the flame and the incident rays that go too the mirror onto the OH. Imagining that the OH is hinged to the mirror, flip it over so that your traced flame is now behind the mirror. Can you now see that this is what our eyes perceive when we look at an image in a plane mirror? Once convinced, remove the OH and clean it off please.
7. Now draw a perfectly horizontal ray from the top of the flame to the mirror, which would of course reflect straight back at 0° from the normal. Extend the ray line behind the mirror with a thick dotted line to the edge of the grid. Repeat for the bottom of the flame.
8. Extend "ray 1 reflected" backwards behind the mirror until it crosses your horizontal dotted line below it. This intersection shows where your eye sees the image of the top of the flame!
9. Repeat for "ray 2 reflected" until it crosses the other, lower dotted horizontal line. This intersection shows where your eye sees the image of the bottom of the flame!
10. Sketch the image of the flame, as seen by your eyes, behind the mirror. How far does this image appear to be?

Your brain and your eyes can't believe that light bends, so they perceive that an object is in a straight line behind a mirror! ***Since rays don't converge in front of a plane mirror, a "virtual image" of an object can occur where the rays converge <u>behind the mirror</u>.***