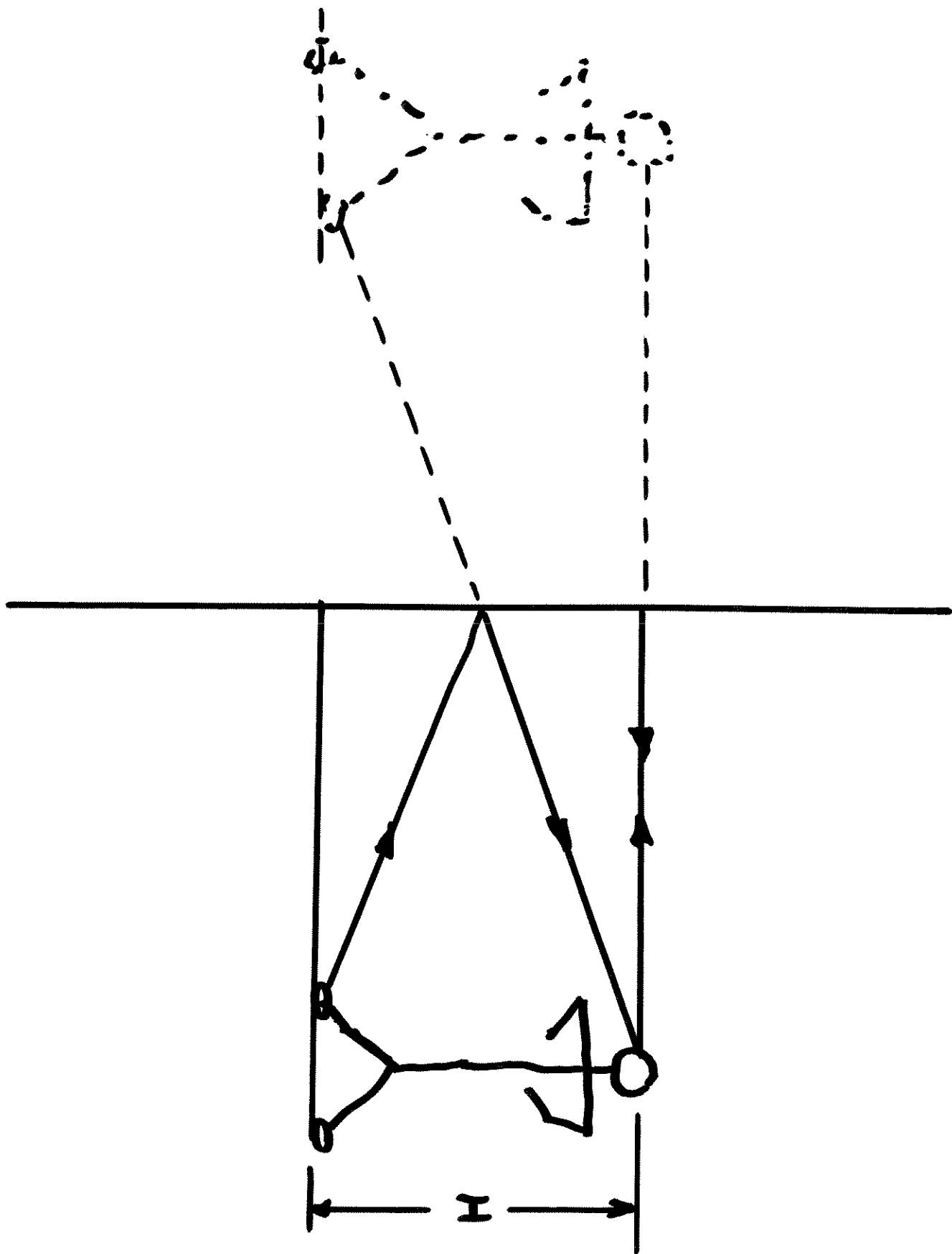
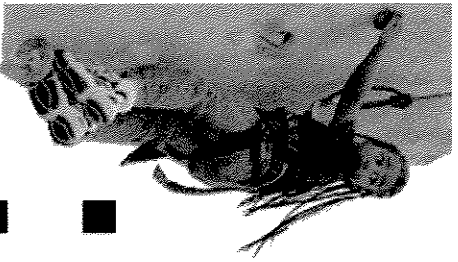


Lecture

4/5/05





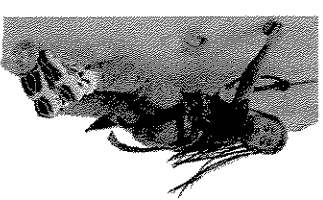


# Foothold Ideas 1:

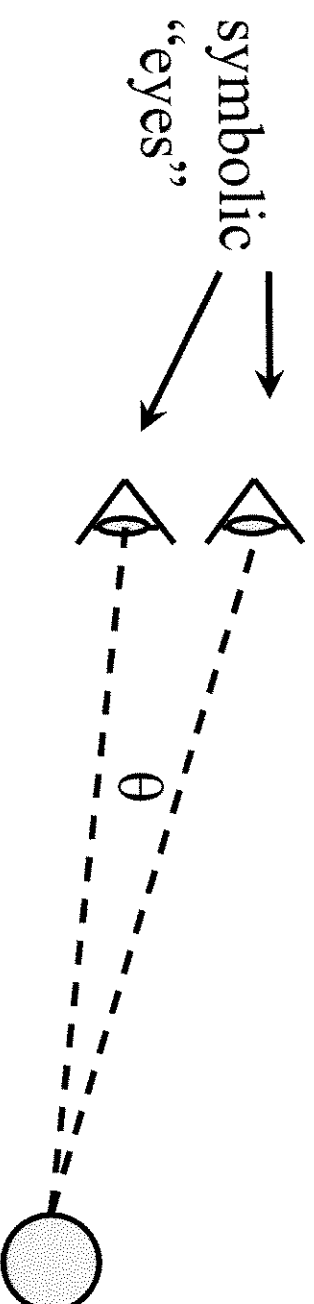
## The Ray Model of Light

- Certain objects (the sun, bulbs,...) give off light.
- Each point on an object scatters light, spraying it off in all directions.
- Through empty space (or  $\sim$ air) light travels in straight lines.
- We only see something when light coming from it enters our eyes.
- Our eyes identify a point as being on an object when rays traced back converge at that point.

# Deciding where something is



- The M&T method (the fact that each eye has to point slightly differently to be directed at an object) is the dominant mechanism for nearby objects.

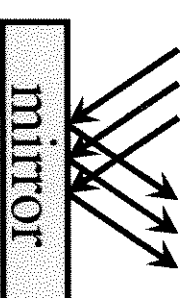
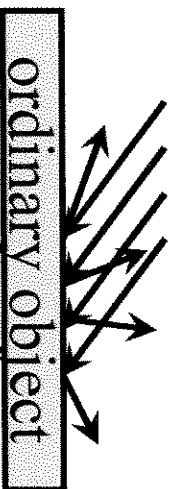


- Our eyes identify a point as being on an object when rays traced back converge at that point.

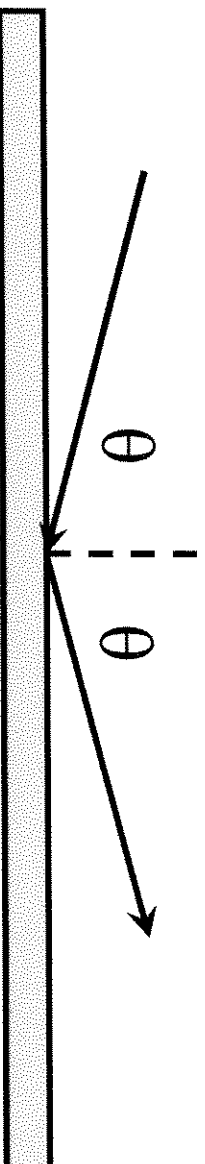
# Foothold Ideas 2:

## Mirrors

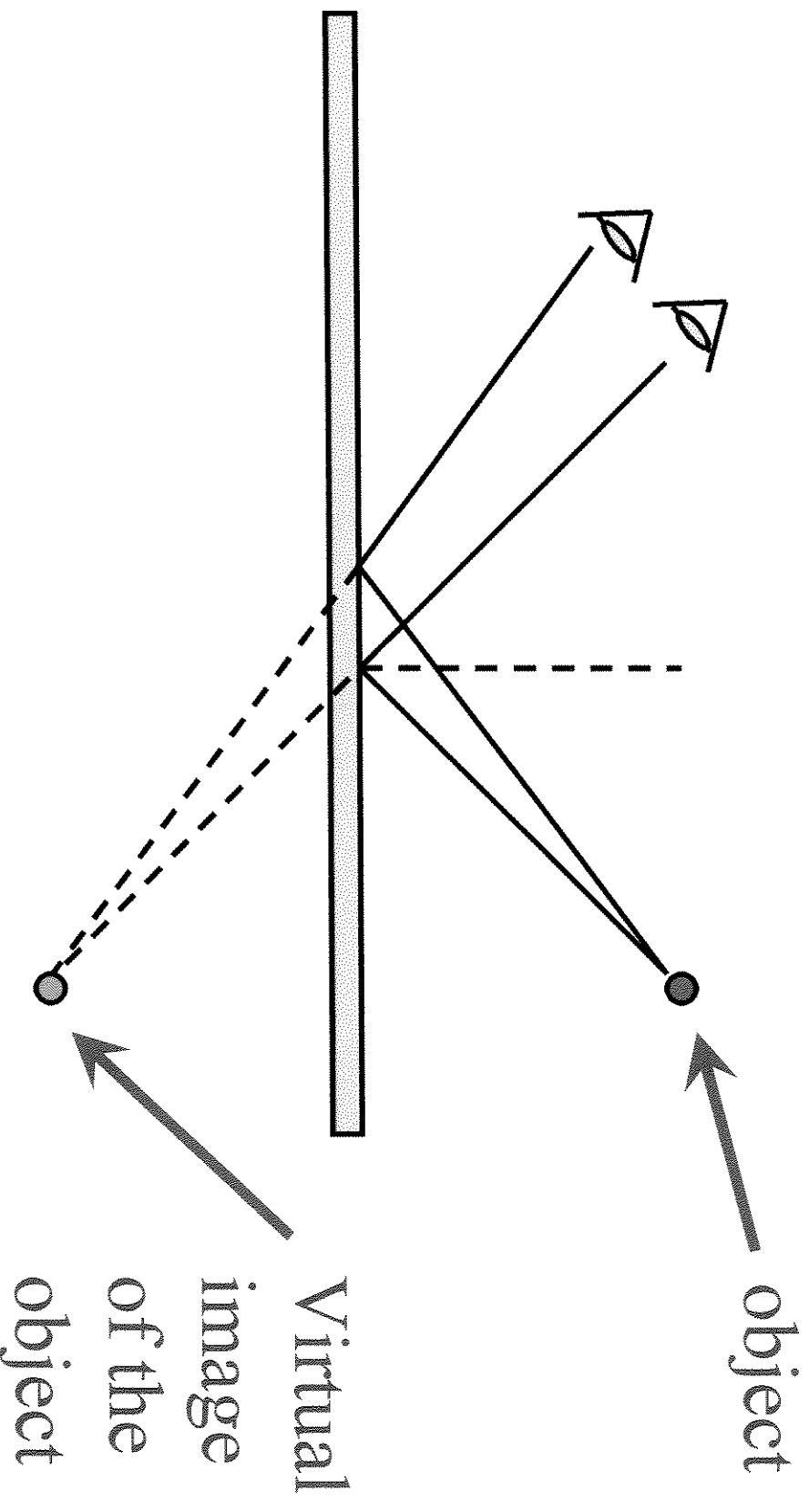
- For most objects, light scatters in all directions.
- For some objects (mirrors) light scatters from them in controlled directions.



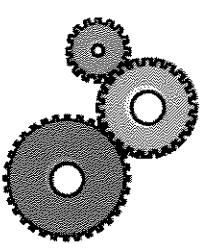
- A polished surface reflects rays back again according to the rule: *The angle of incidence equals the angle of reflection.*



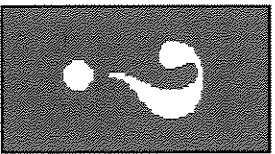
Where does an object seen in a mirror appear to be?



# Kinds of Images: *Virtual*



- In the case of the previous slide, the rays seen by the eye do not actually meet at a point.
- When the rays seen by the eye do not meet, but the eye assumes they do, the image is called *virtual*.
- If a screen is put at the virtual image, there are no rays so nothing will be seen on the screen.

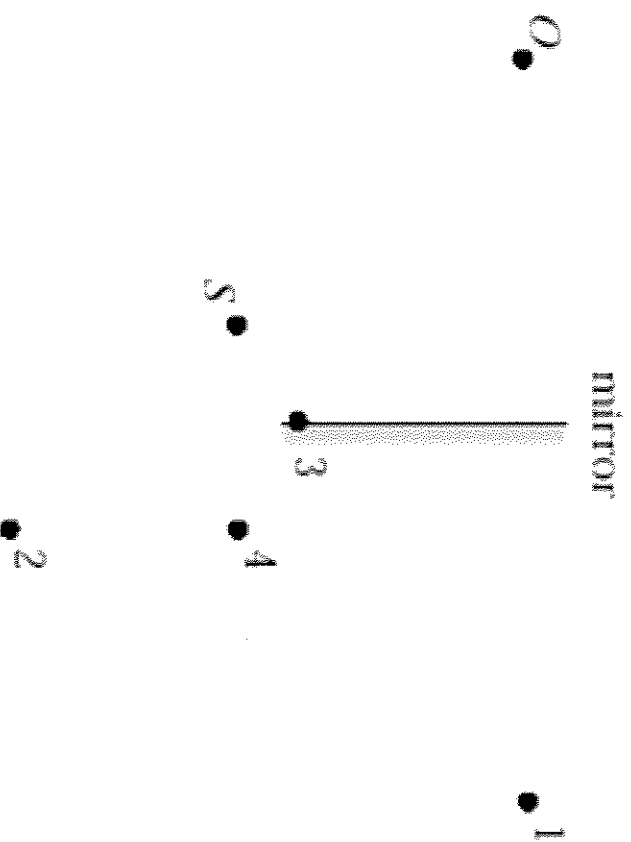


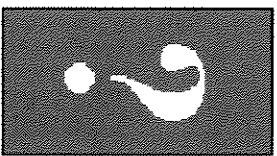
# Puzzle



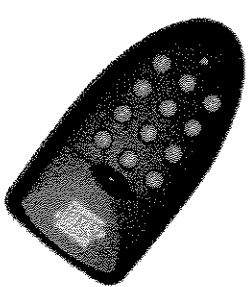
- An observer  $O$ , facing a mirror, observes a light source  $S$ . Where does  $O$  perceive the mirror image of  $S$  to be located?

1. 1
2. 2
3. 3
4. 4
5. Some other location.
6. The image of  $S$  cannot be seen by  $O$  when  $O$  and  $S$  are located as shown.





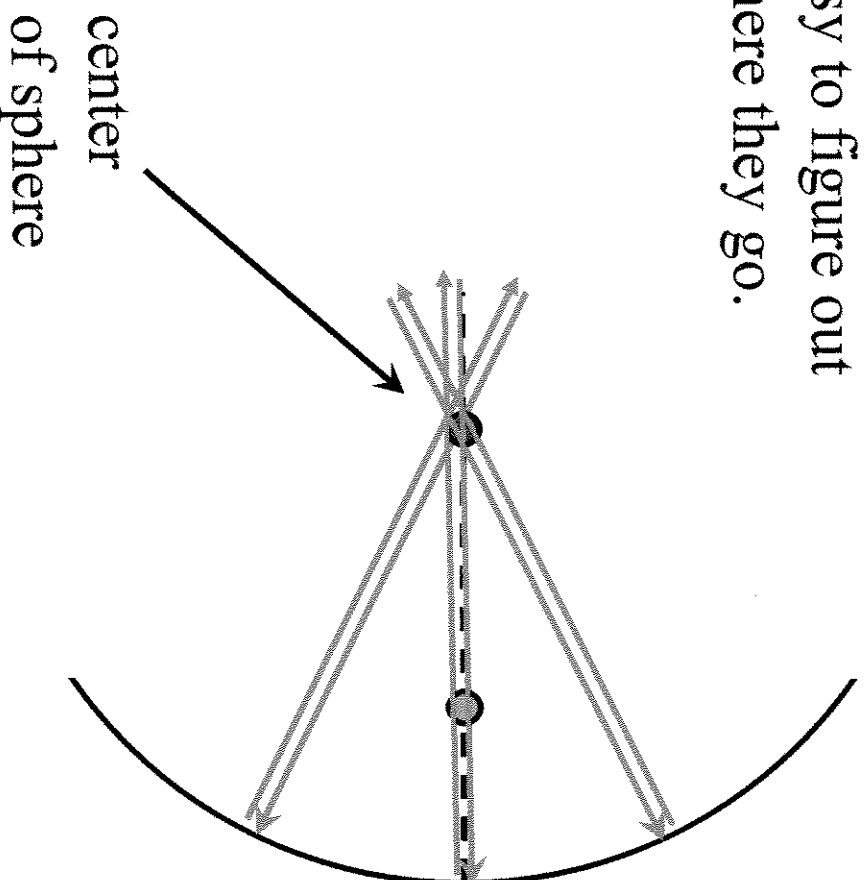
# Puzzle



- How large a mirror do you need in order to see your whole body?
  - 1. You can see yourself in any size mirror if you go back far enough.
  - 2. Half your size.
  - 3. As big as you are.
  - 4. Some other answer.

# A Spherical Mirror: Central Rays

A few rays are easy to figure out where they go.

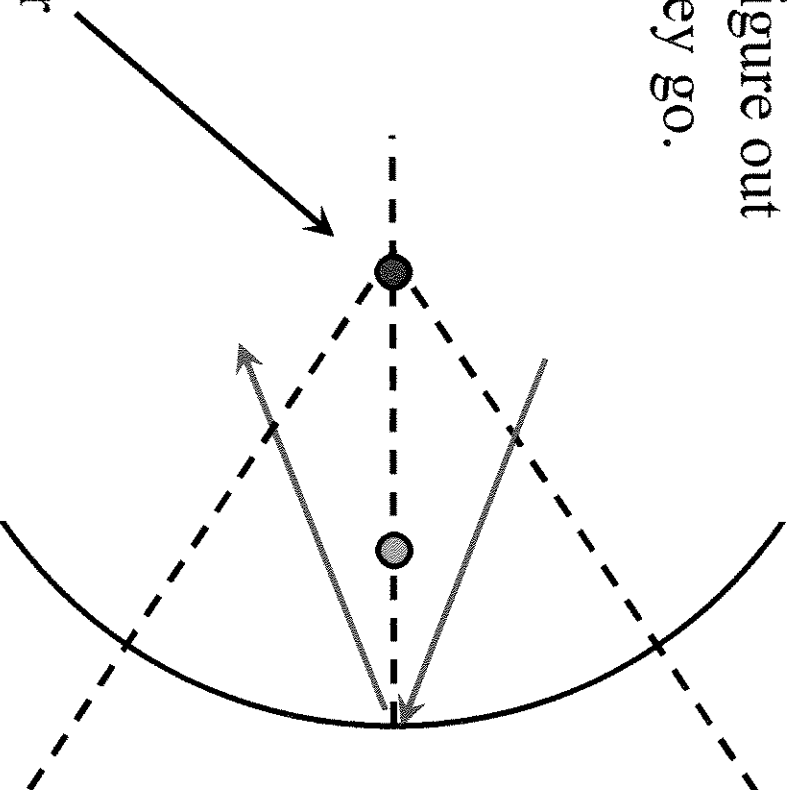


All rays satisfy the “angle of incidence = angle of reflection” measured to the normal to the surface

All rays through the center strike the mirror perpendicular to the surface and bounce back along their incoming path.

# A Spherical Mirror: Central Ray

A few rays are easy to figure out where they go.

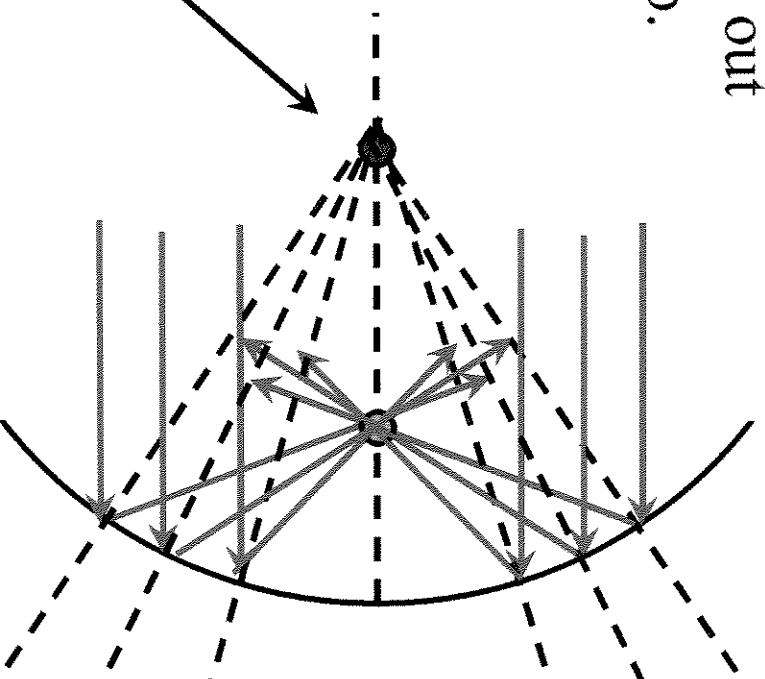


All rays satisfy the “angle of incidence = angle of reflection” measured to the normal to the surface

The ray hitting the central line of the diagram is particularly simple.

# A Spherical Mirror: Parallel Rays

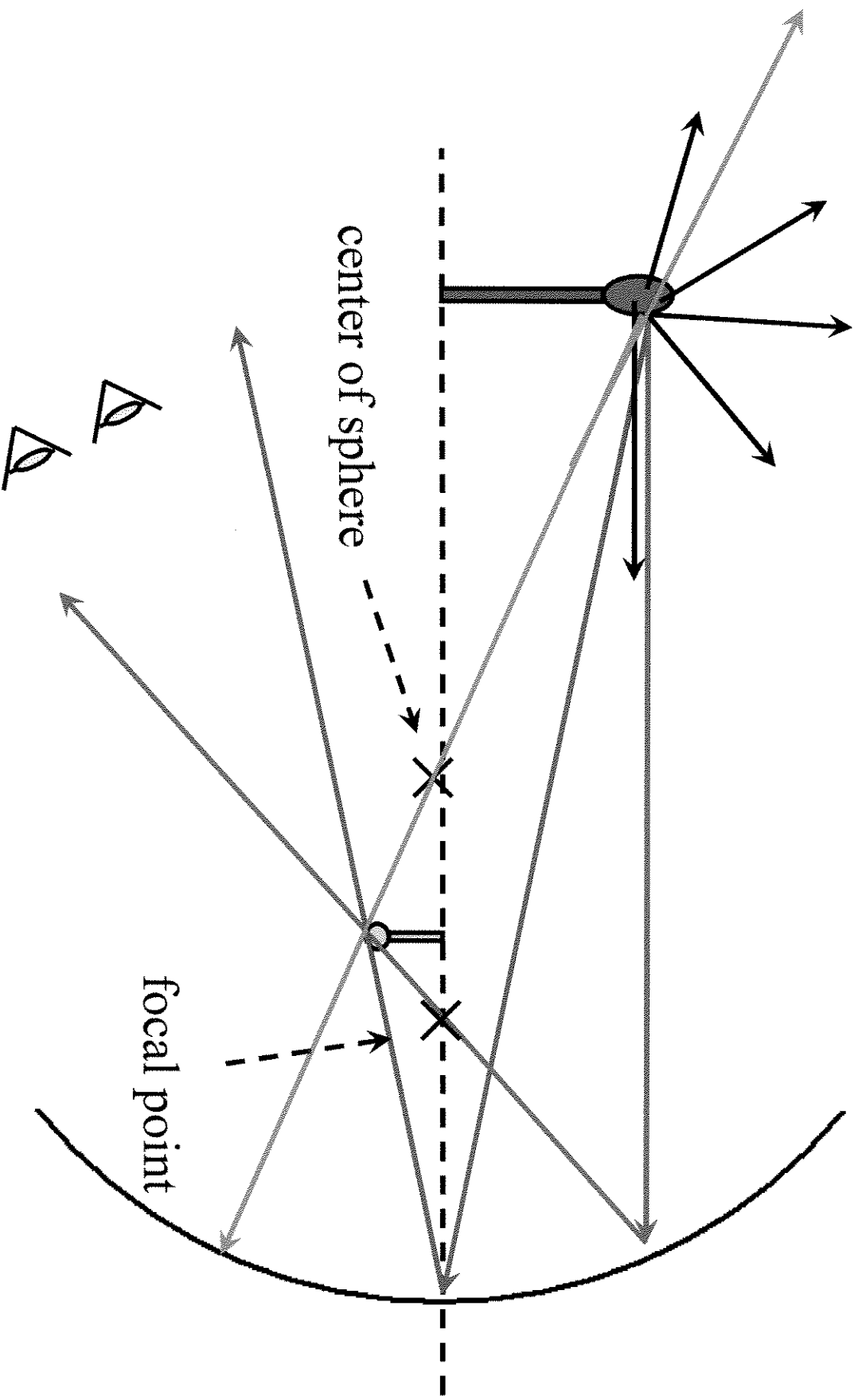
A few rays are easy to figure out where they go.



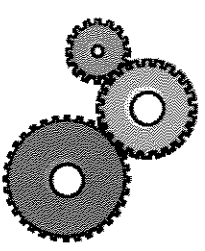
All rays satisfy the “angle of incidence = angle of reflection” measured to the normal to the surface

All rays parallel to and near an axis of the sphere reflect through a single point on the axis (the focal point)

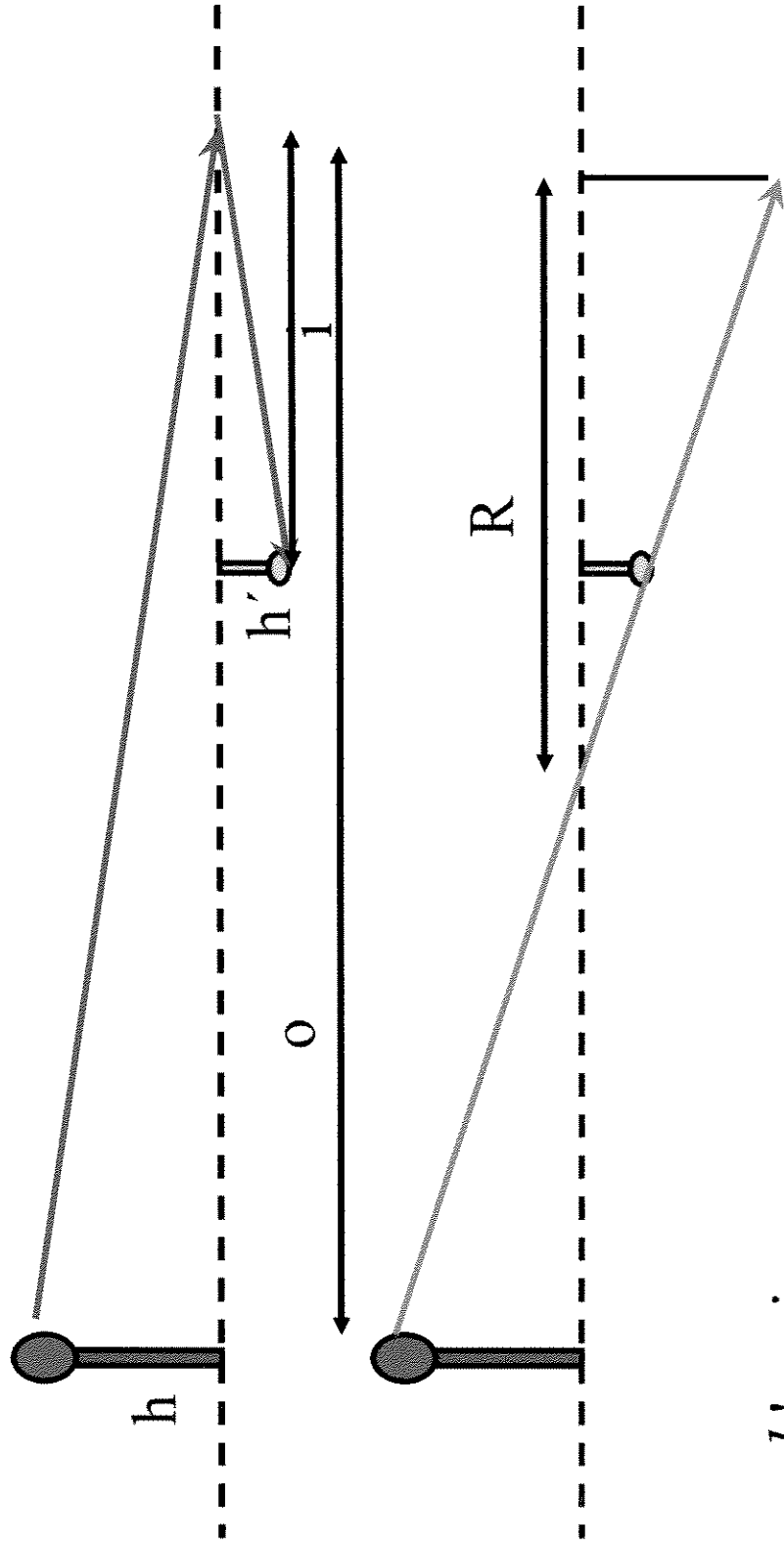
# Images in a Spherical Mirror: 1



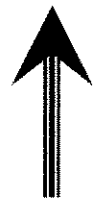
# Kinds of Images: Real



- In the case of the previous slide, the rays seen by the eye do in fact converge at a point.
- When the rays seen by the eye do meet, the image is called *real*.
- If a screen is put at the real image, the rays will scatter in all directions and an image can be seen on the screen, just as if it were a real object.
- What will it look like if there is no screen?



$$\frac{h'}{h} = \frac{i}{o} = \frac{R-i}{o-R}$$



$$\frac{1}{f} = \frac{1}{i} + \frac{1}{o} \quad f = R/2$$