

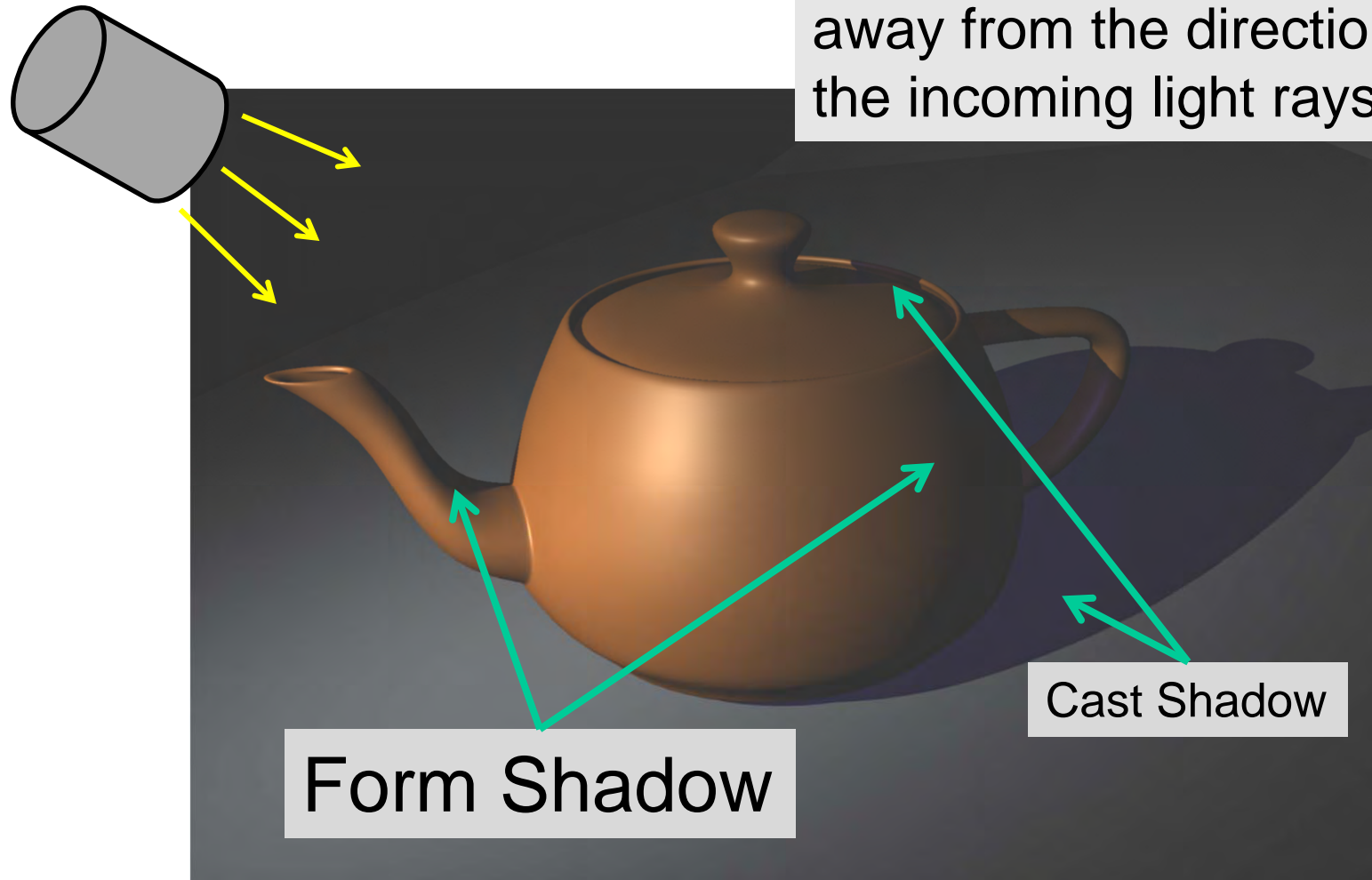
Lights & Shadows Part 2



National Science Foundation
WHERE DISCOVERIES BEGIN

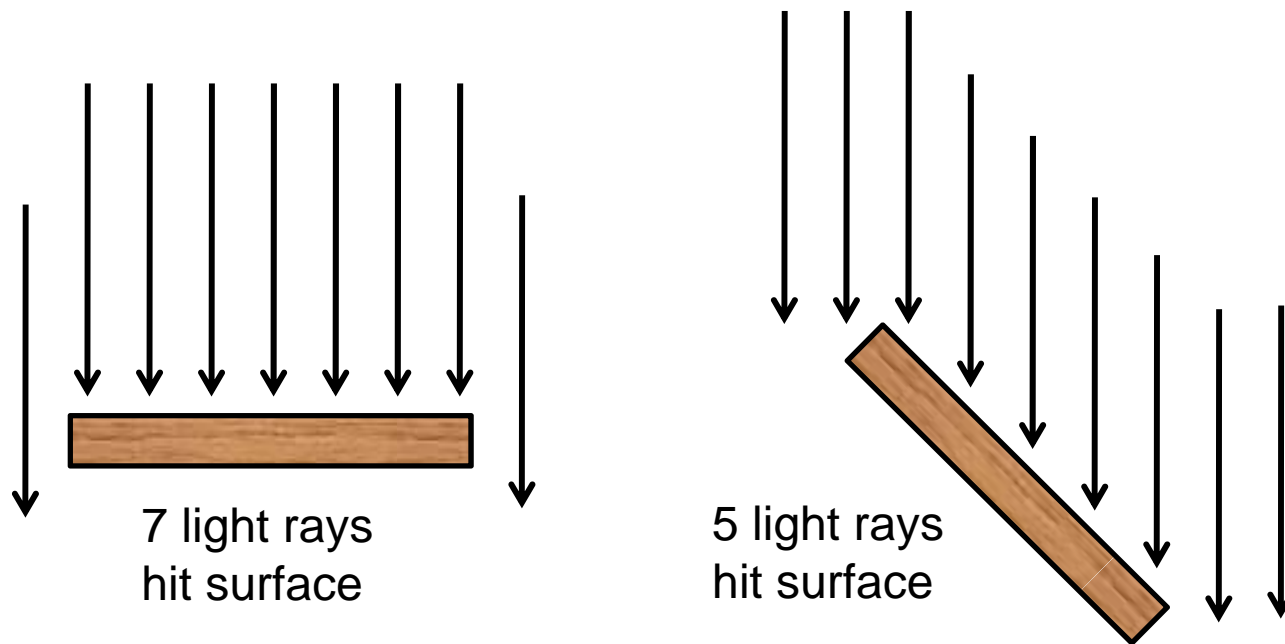
Form Shadows

Form shadows occur when a surface is angled facing away from the direction of the incoming light rays.



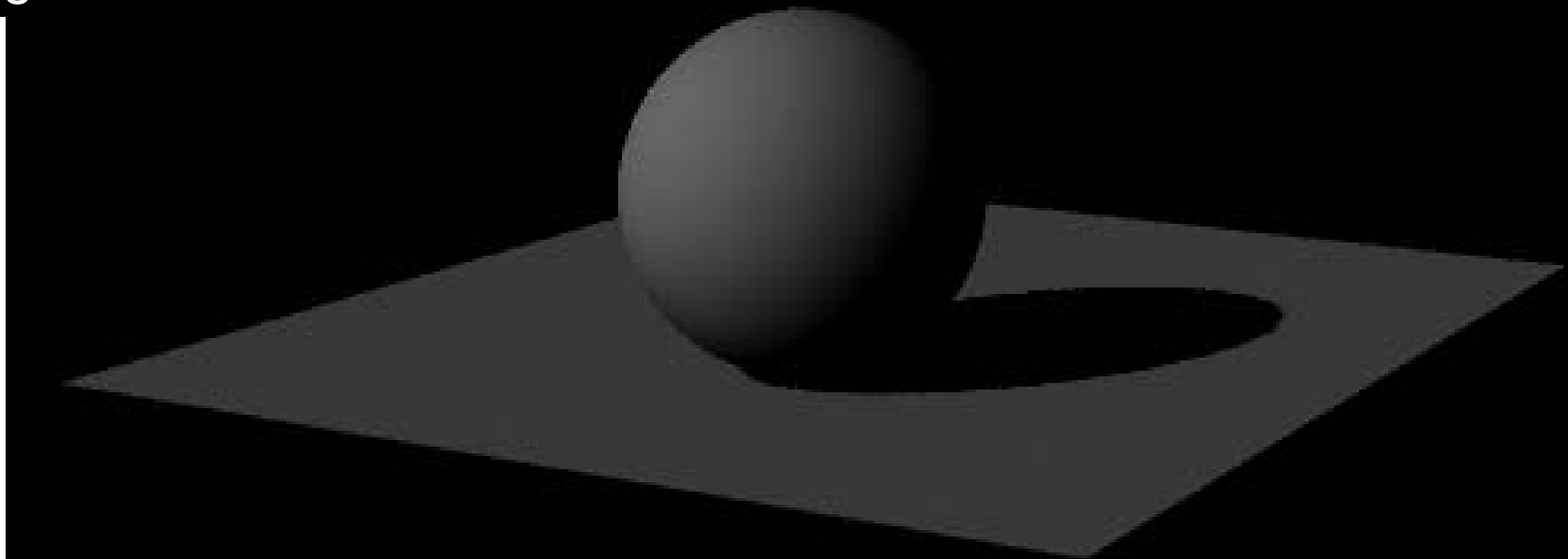
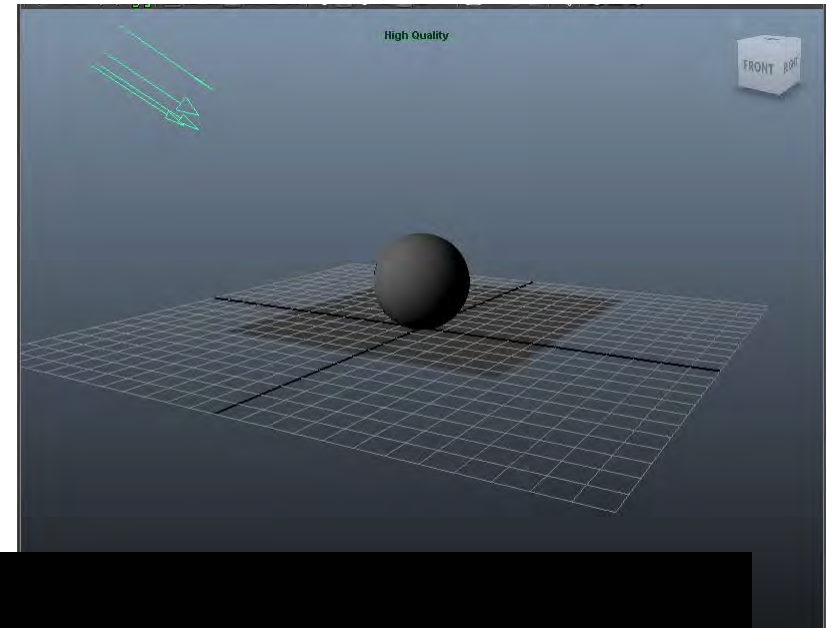
Light Intensity & Angle

As angle between the light and a surface increases, the intensity of the light on the surface decreases because it is spread over a larger area.



Light Intensity & Angle

Light intensity on the surface decreases as the form turns away from the directional light source.



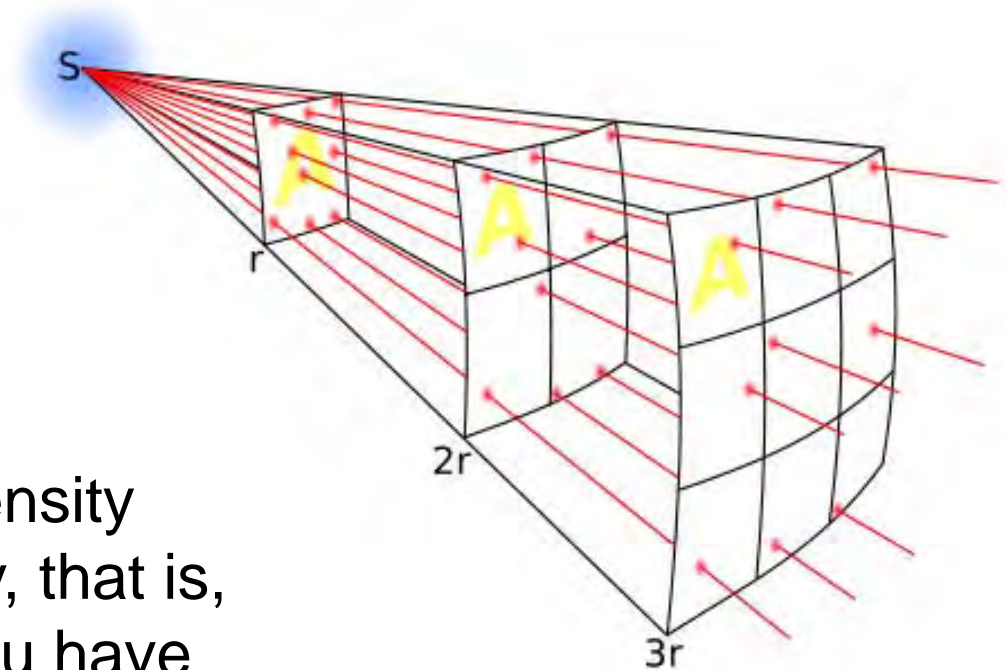
Diffuse (Lambert) surface with a directional light source

Light Intensity & Distance

The intensity of light decreases as we get farther from a non-directional light source.

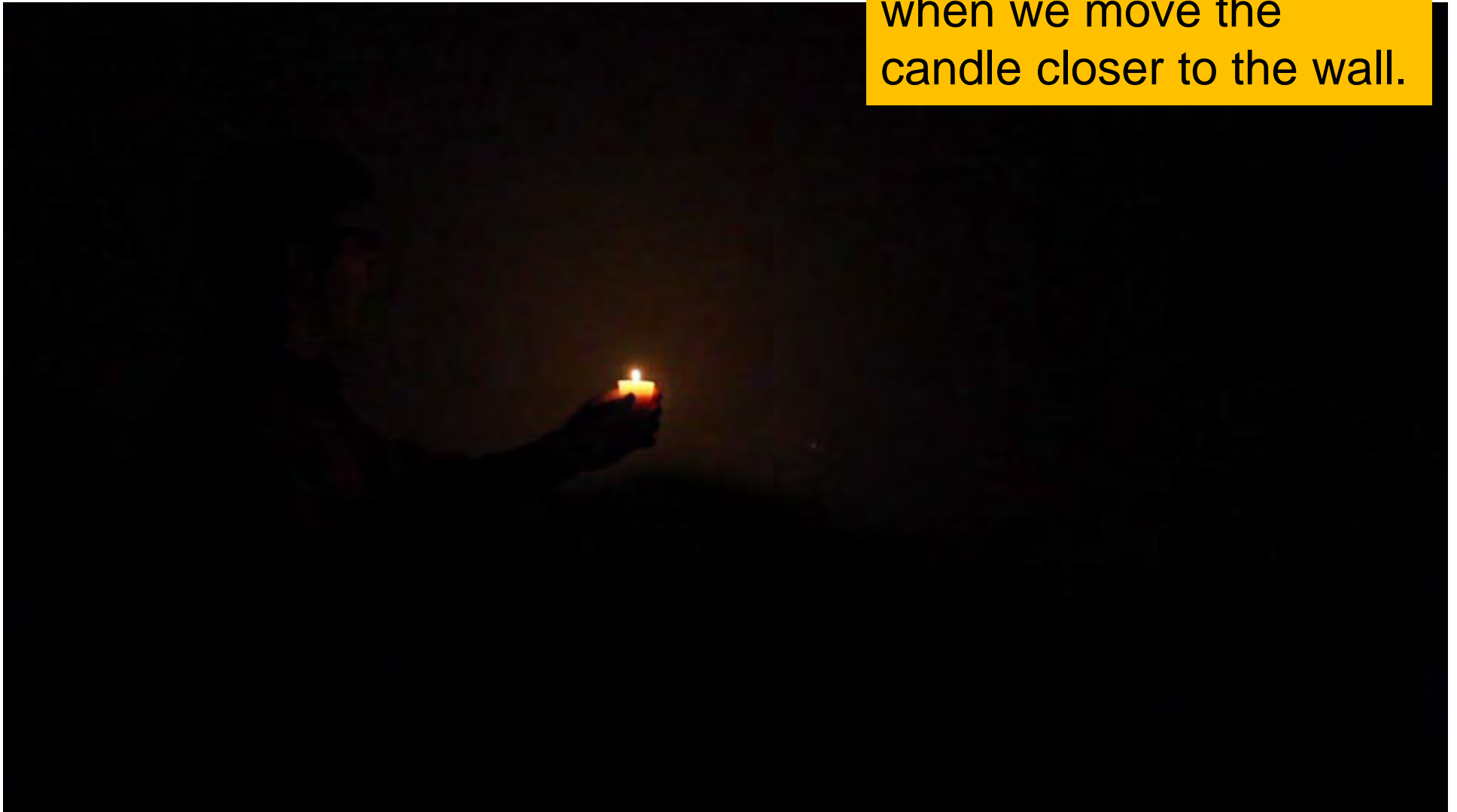
The light gets weaker because it is spread over a larger area.

For a point light the intensity decreases quadratically, that is, at twice the distance you have four times less intensity.

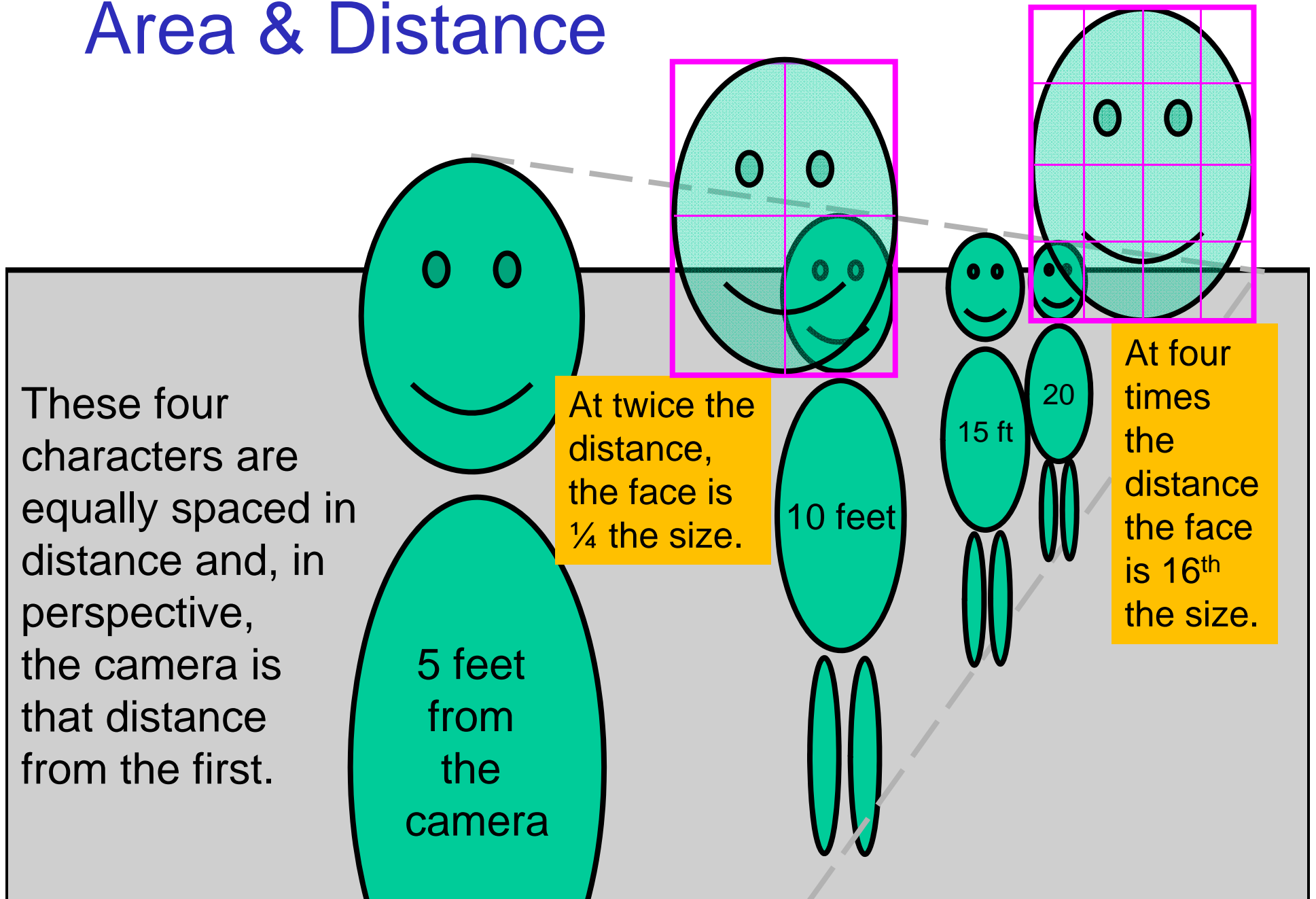


Candle near a Wall

Candle light on the wall is significantly brighter when we move the candle closer to the wall.



Area & Distance

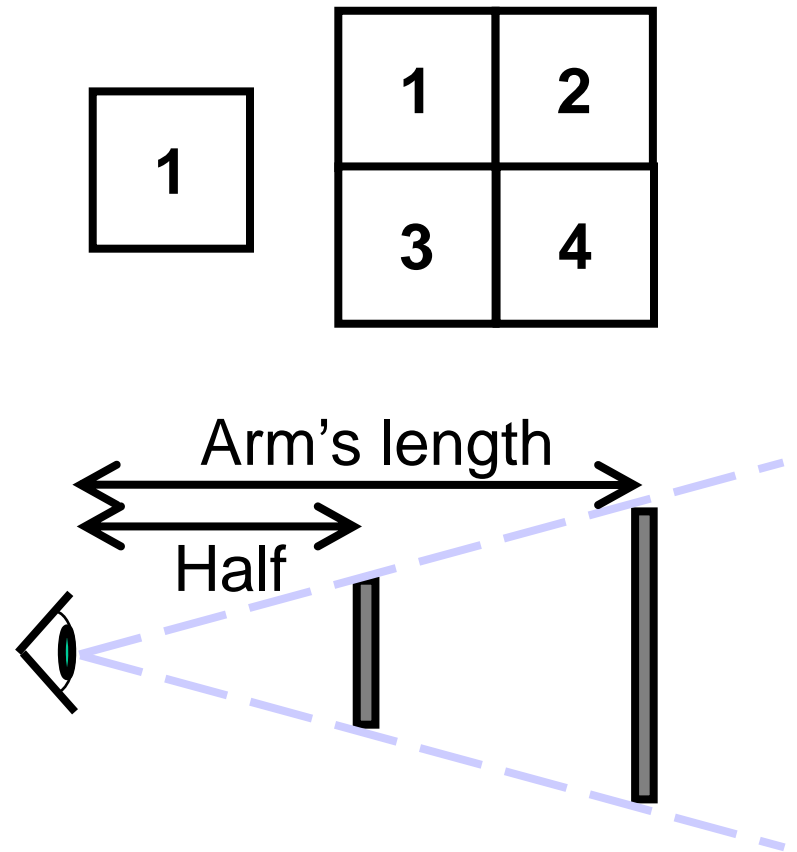


Perspective Cards

Hold the large card at arm's length.

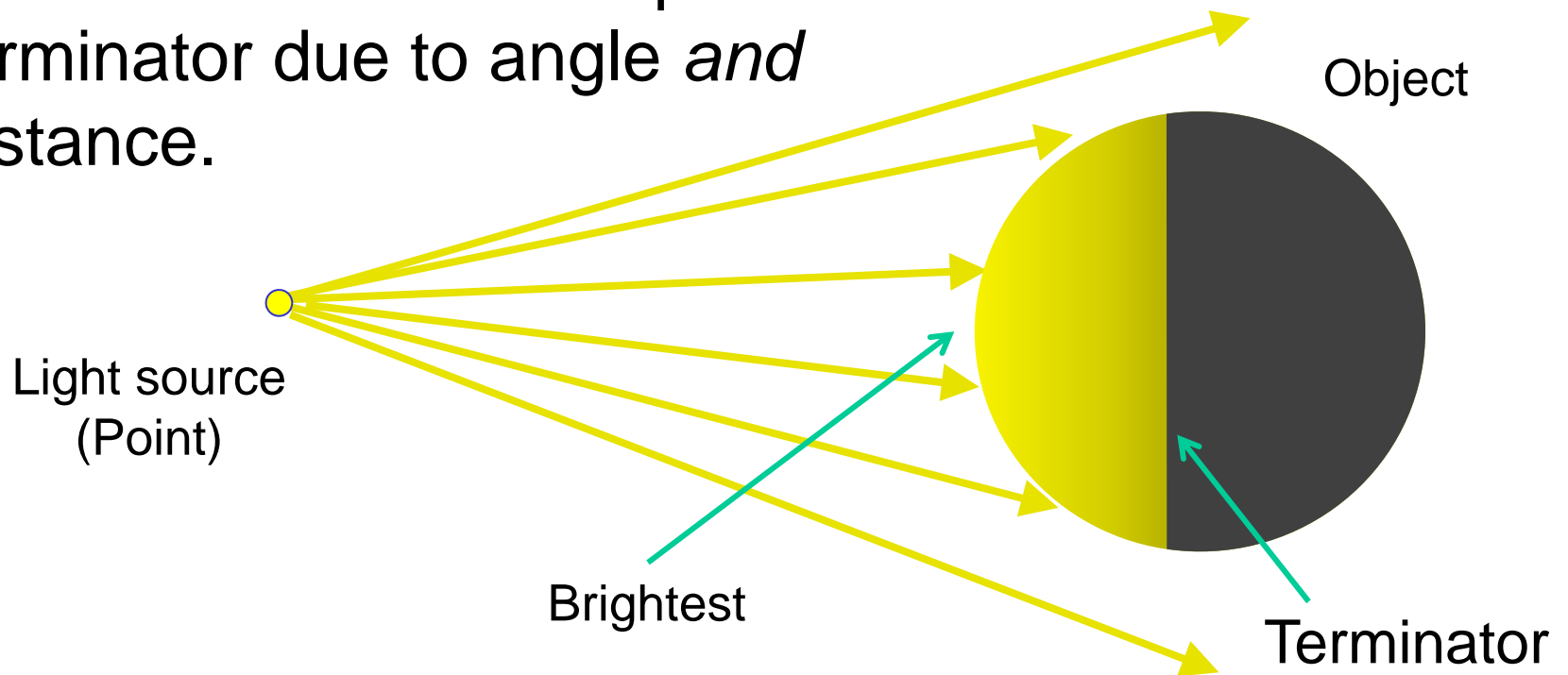
Close one eye then hold small card such that you see it as same size as large card.

The small card will be half way between your eye and large card.



Form Shadow for Point Light Source

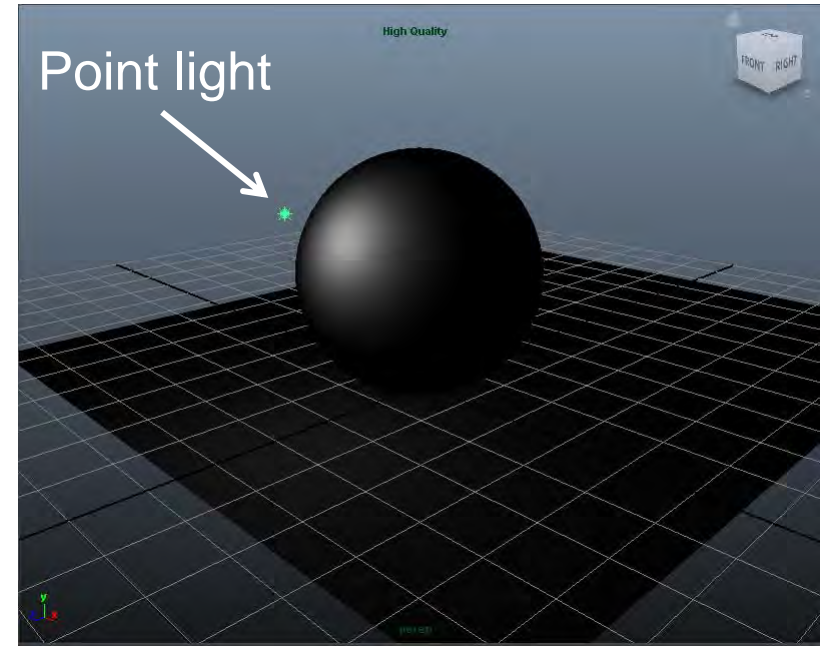
Object is brightest where the rays hit head-on and dims up to the terminator due to angle *and* distance.



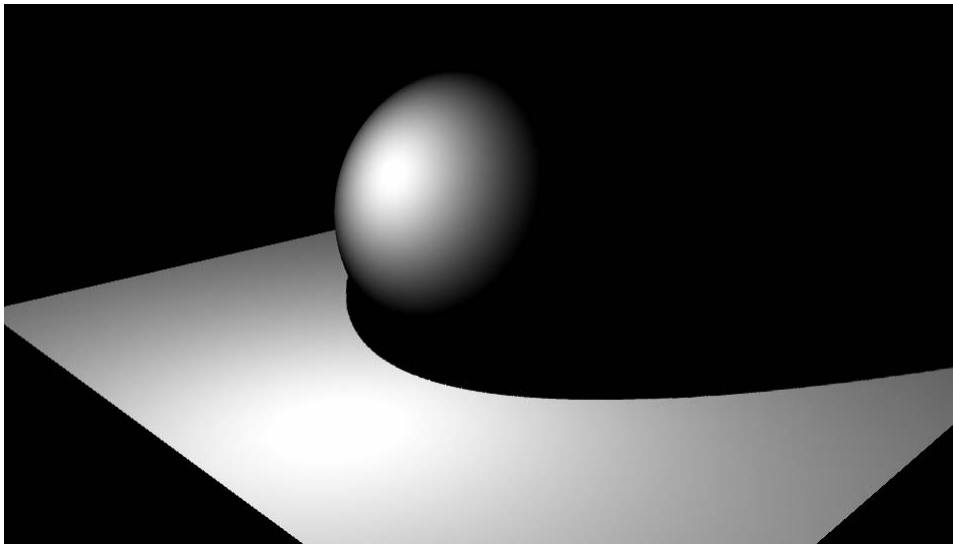
The occluded side is completely dark if the point source is the only light source (i.e., no ambient or reflected light).

Point Light Source

The decay of intensity with distance is adjustable for CG point light sources.

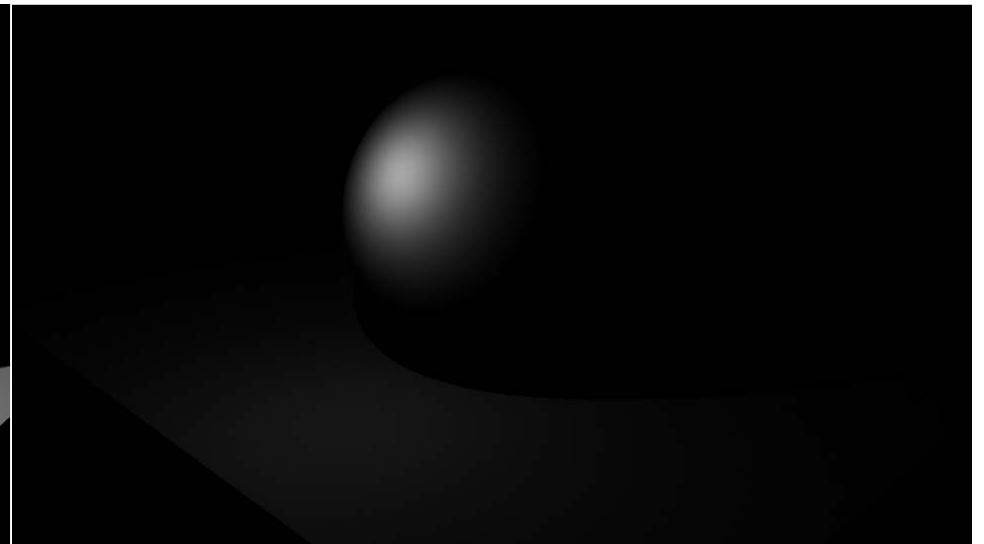


No decay (unphysical)



Form shadow only due to angle

Quadratic decay



Form shadow from angle *and* distance

Ambient Light

Ambient

Direct

Direct

Ambient

Direct

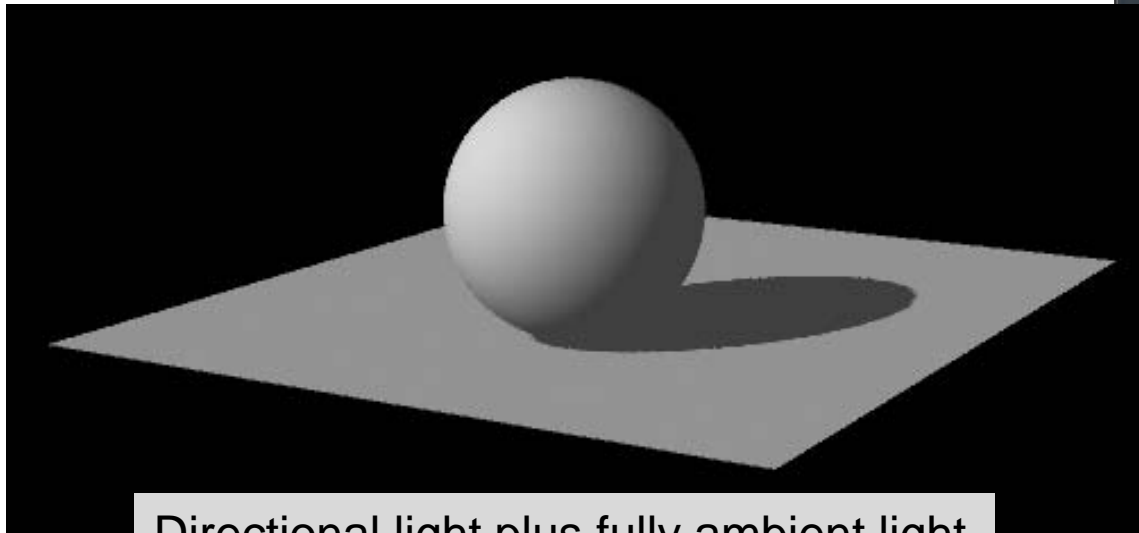
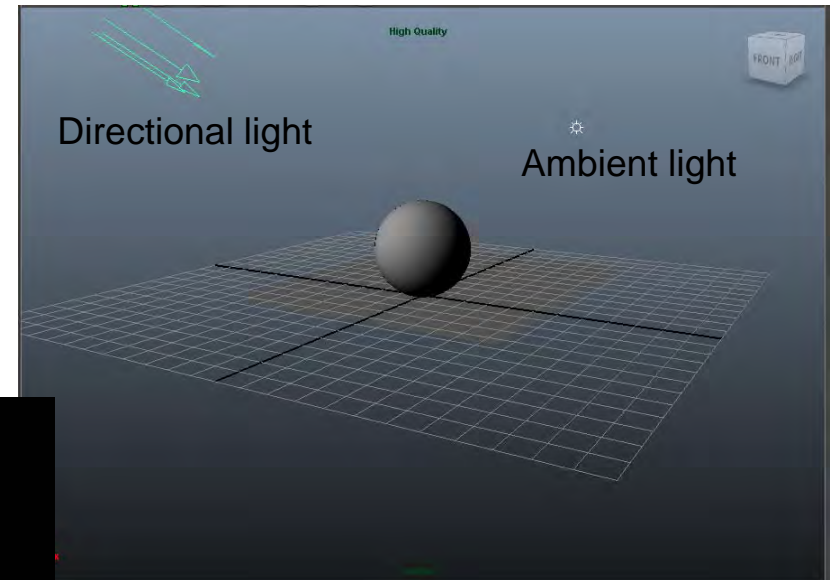
Ambient

Most lighting is indirect, coming not from a light source but from reflections off of other surfaces.

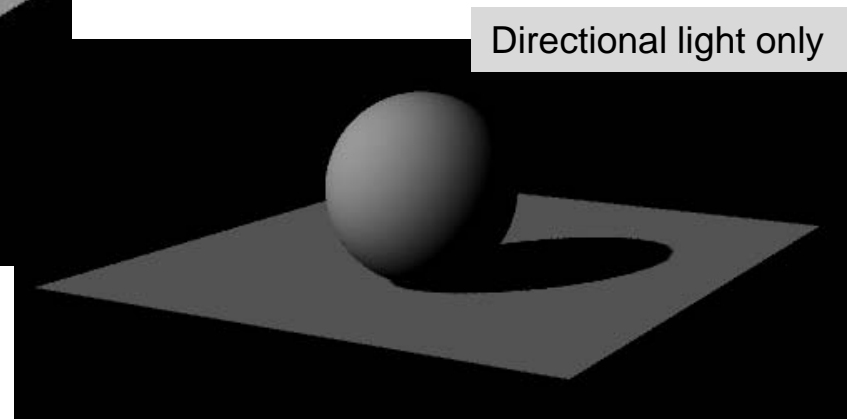


Ambient Light in Maya

Ambient light may be:
fully ambient (ambient shade = 0);
point light (ambient shade = 1);
or a fractional mix of the two.



Directional light plus fully ambient light

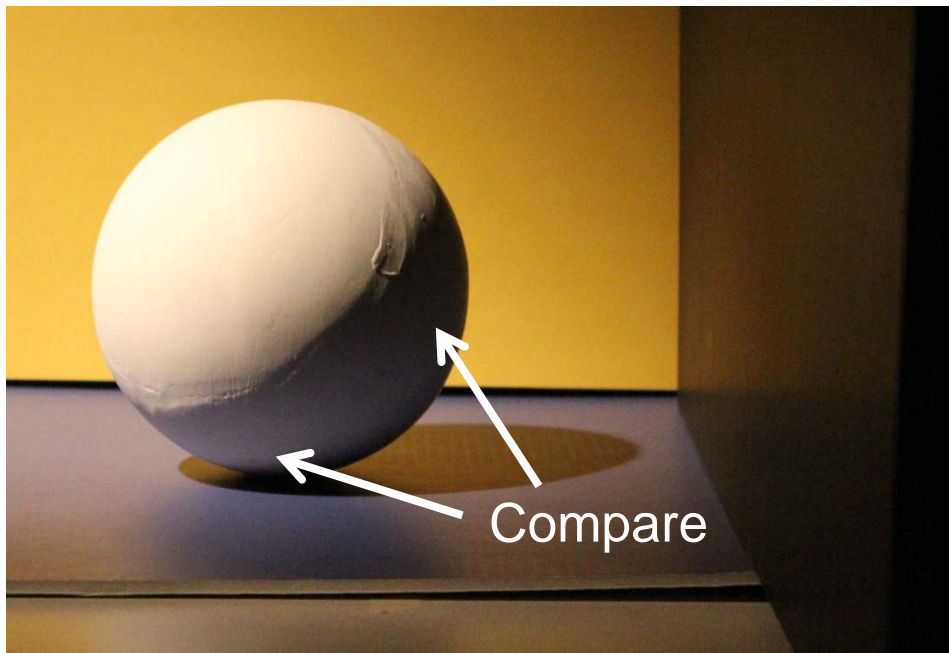
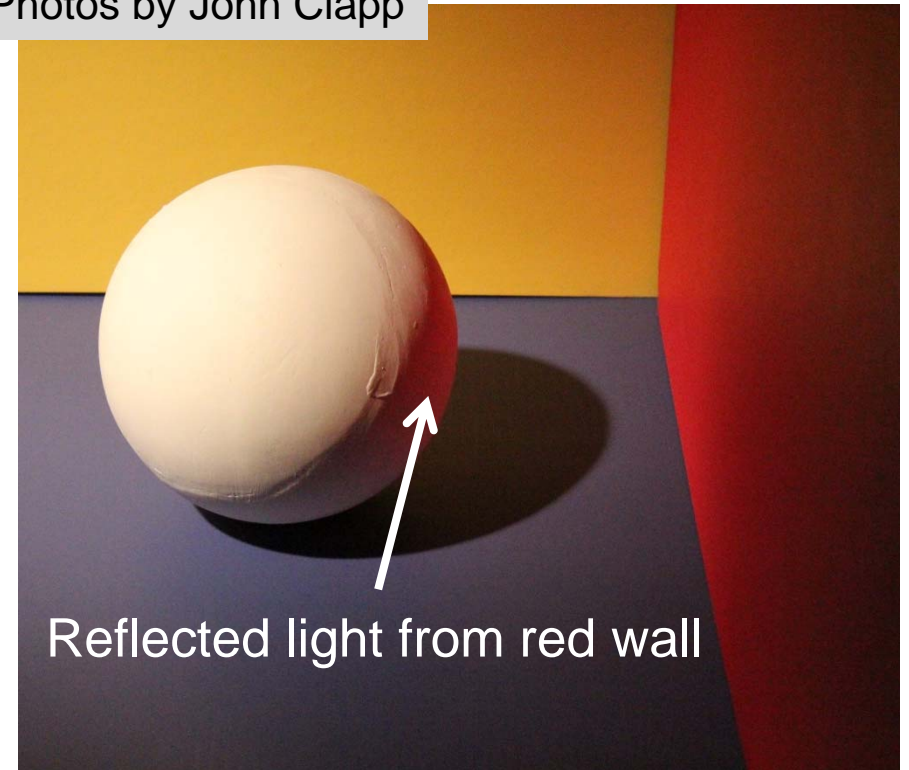


Directional light only

Photos by John Clapp

Reflected Light

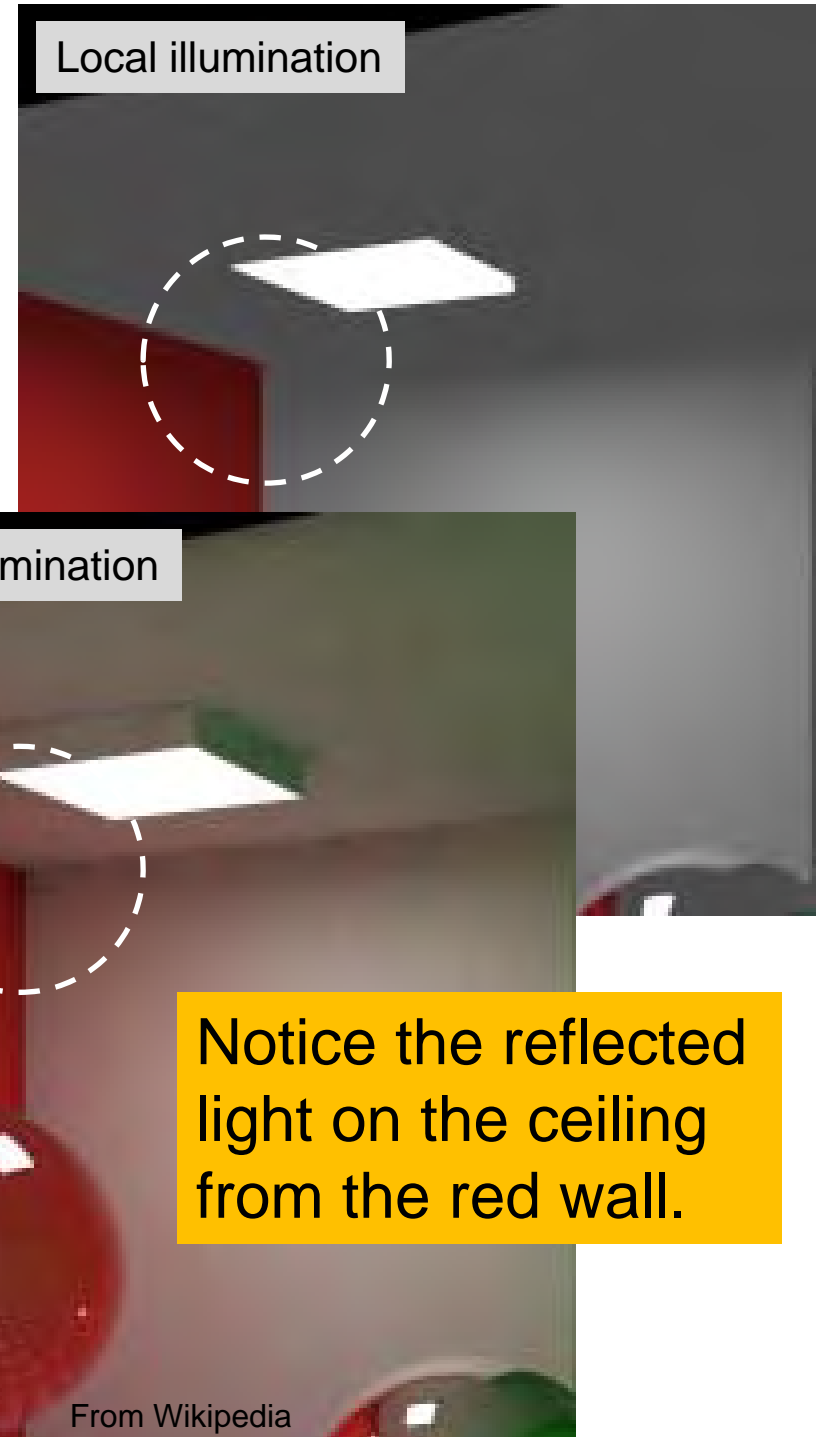
Light can reflect from a surface and illuminate an object, making the surface act as a light source.



Compare the brightness of these two parts of the sphere, one near the black wall and one near the bright floor.

Global Illumination

Global illumination algorithms render a scene using both direct illumination (from light sources) and the light that is reflected by surfaces (indirect illumination).

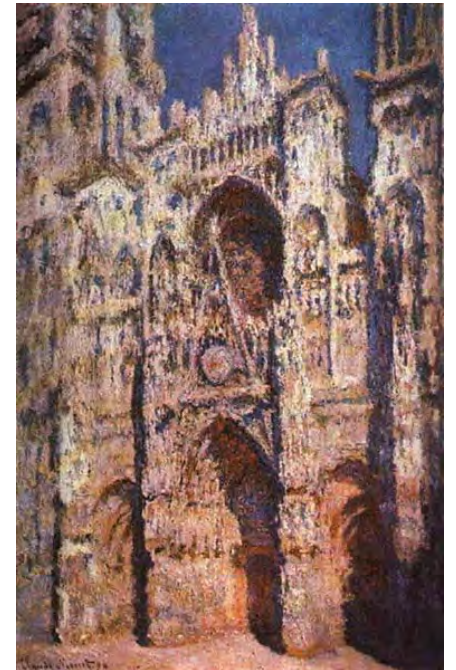


The Sky as a Light Source

On Earth the sky is an important light source during the day. Mostly creates a bluish ambient light with variations due to time of day and weather.



*Rouen Cathedral Series,
Claude Monet*



Occlusion Shadows

Shadows occur even in ambient lighting conditions when an area is occluded, such as a crevice or fold.

On this cloudy day
there are no cast
shadows

...but there is an
occlusion shadow
under the car.



Space Lighting

Moon has no atmosphere
so cast shadows are
very dark since there's
no ambient skylight.



Lunar surface is highly
reflective so there's a
lot of reflected light.

Transformers: Dark of the Moon (2012)



Summary

- Form shadows occur when a surface is angled facing away from the light source.
- Light intensity decreases as the distance from the light source increases.
- Reflection of light from surfaces makes them, effectively, light sources.
- Ambient light is non-directional, typically due to reflected or scattered light.
- The daytime sky is a light source.