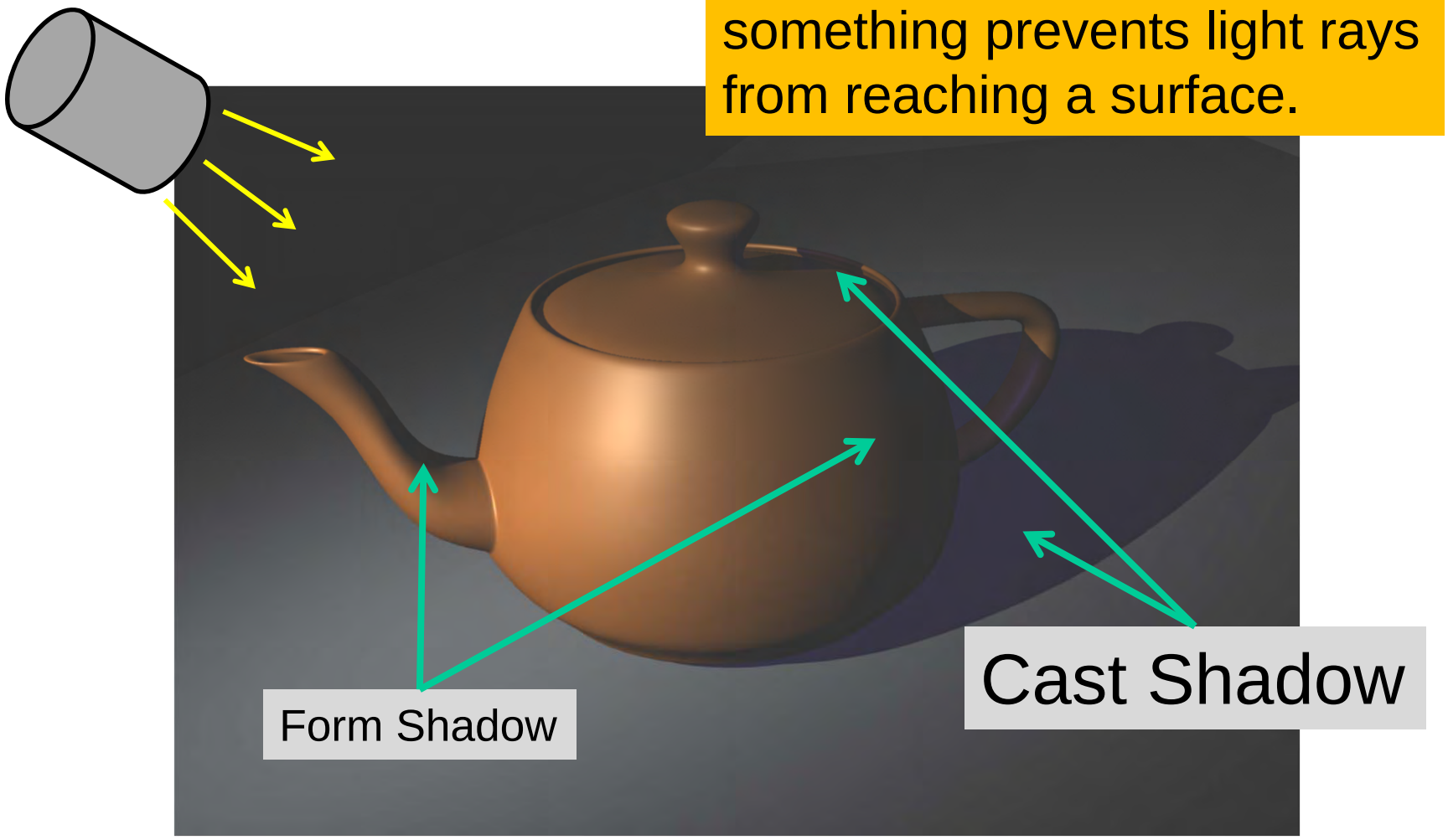
Lights & Shadows Part 1

Cast Shadows

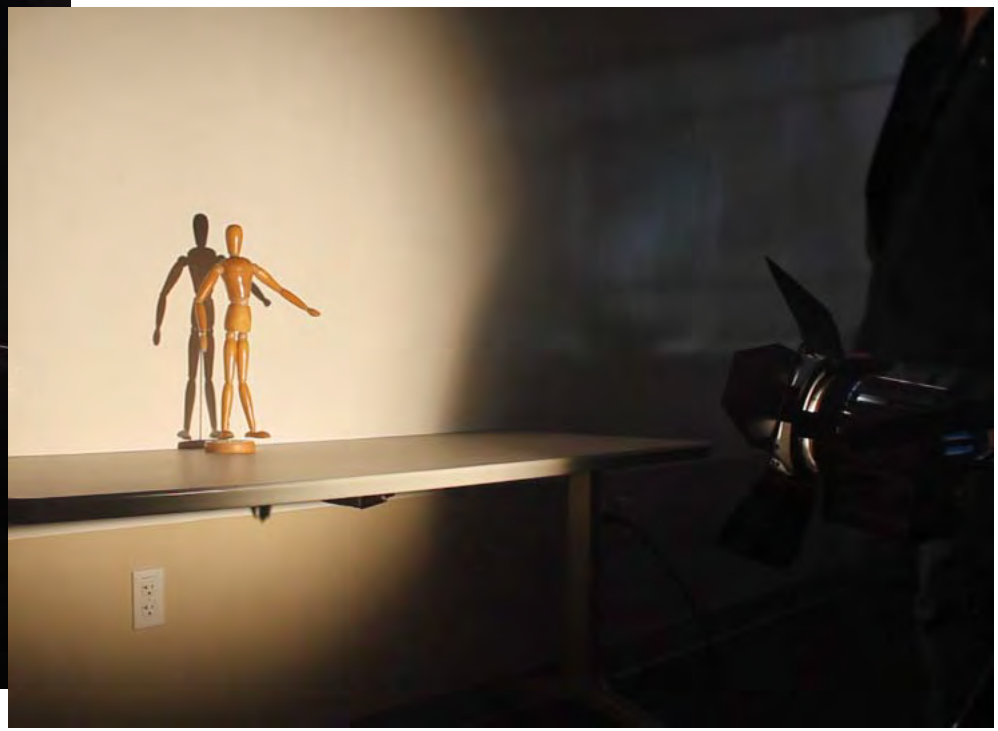
Cast shadows occur when something prevents light rays from reaching a surface.



Cast Shadows

Size and sharpness of a cast shadow may depend on:

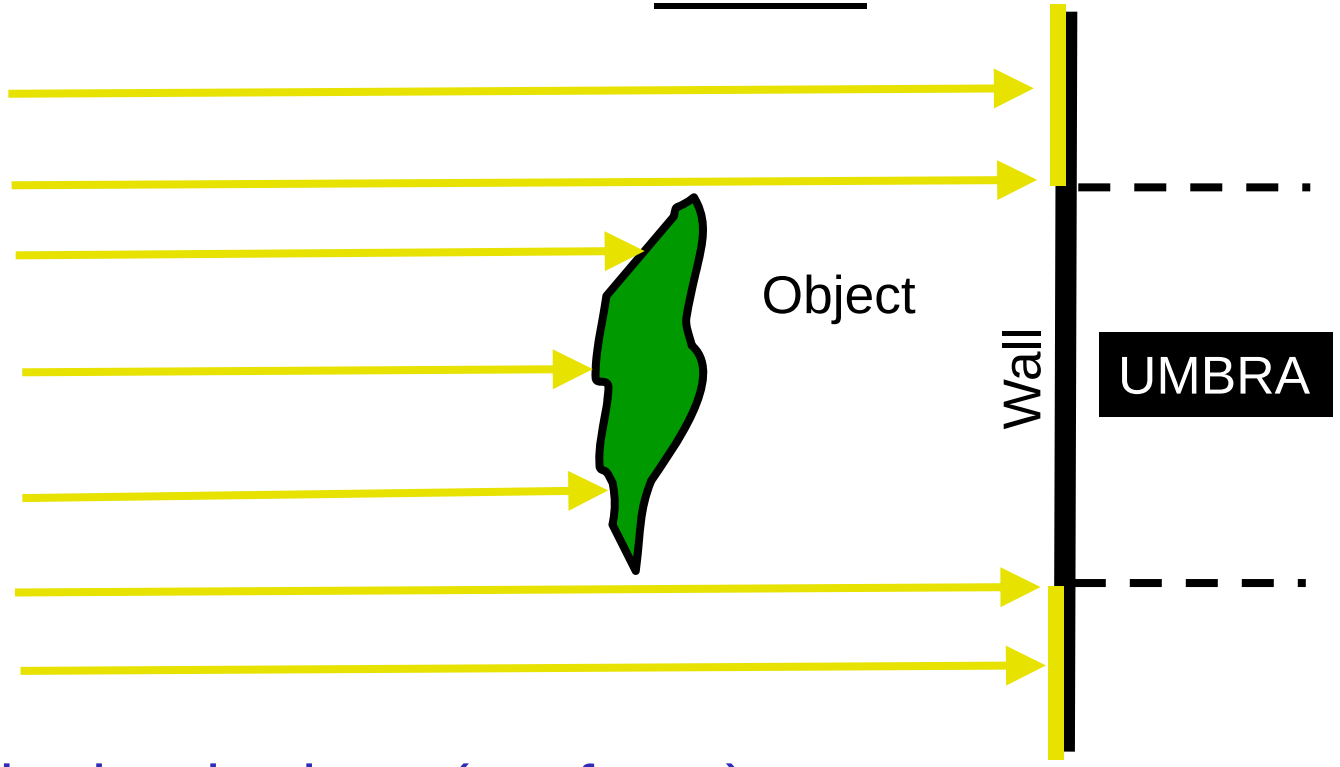
- Size and type of light source
- Distance from light to object
- Distance from object to wall



Cast Shadows

Cast Shadow for Directional Light

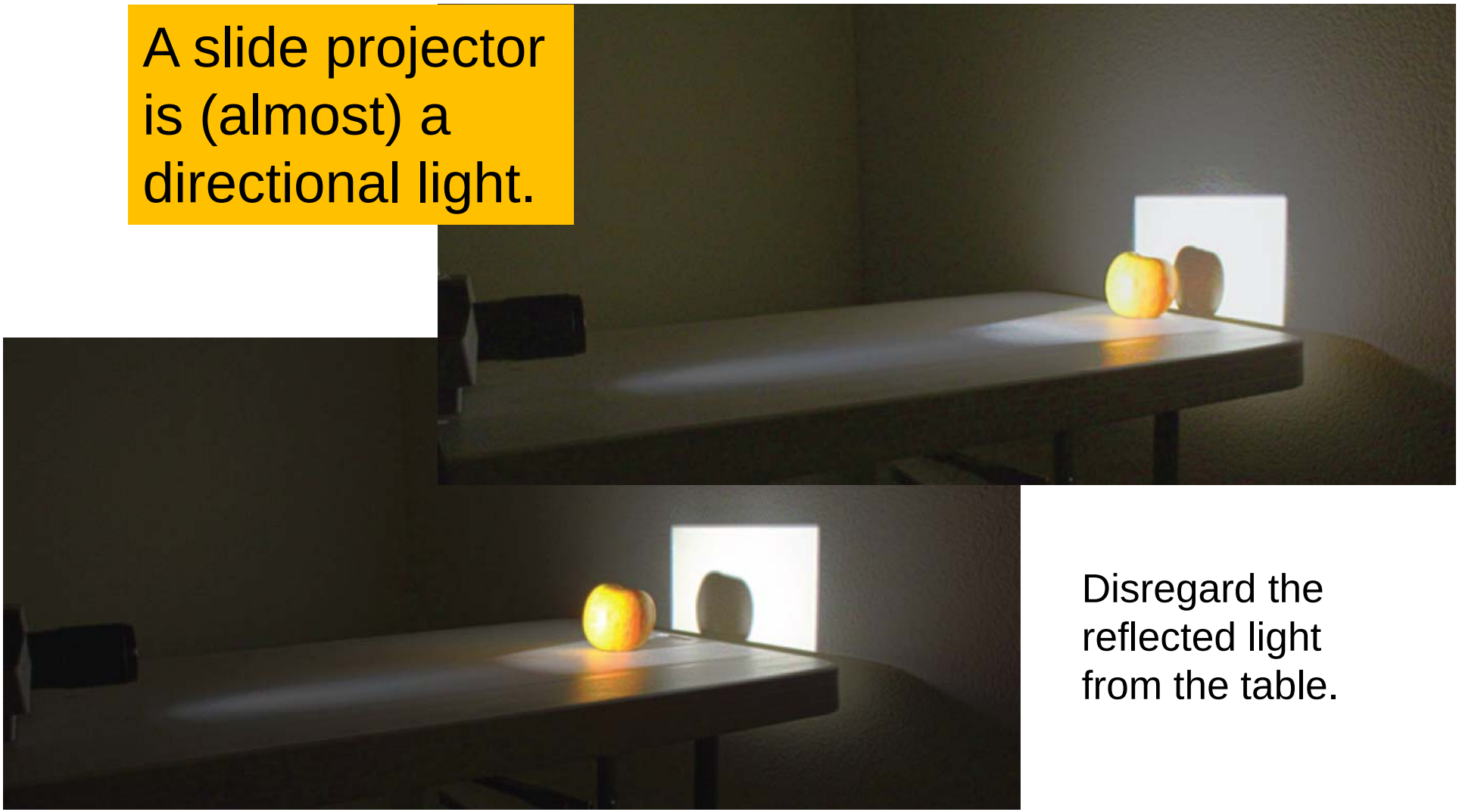
A directional light has parallel light rays so the cast shadow is simple to trace on the wall.
Dark shadow called the umbra.



Shadow is sharp (not fuzzy).

Directional Light Example

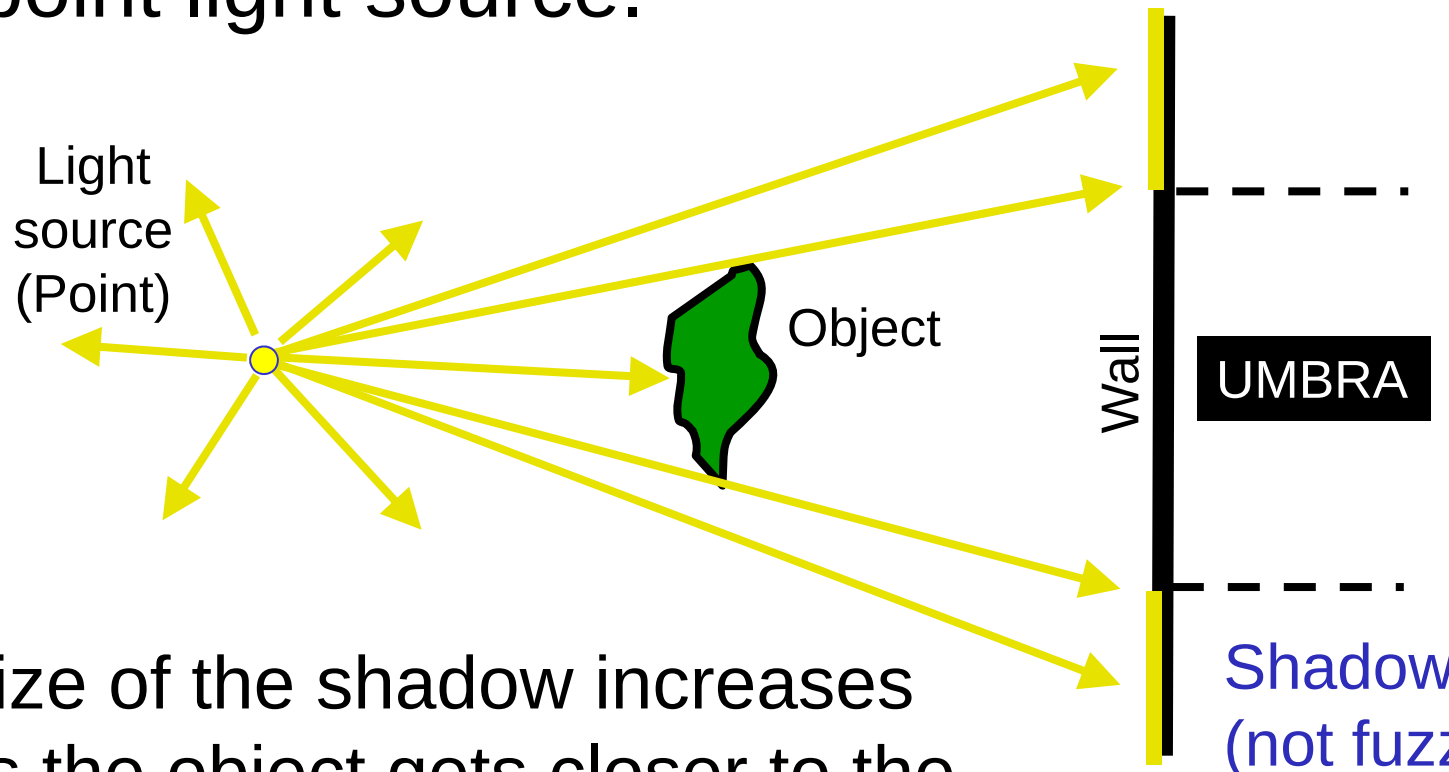
A slide projector is (almost) a directional light.



Disregard the reflected light from the table.

Cast Shadow for Point Light Source

Light rays spread out radially from a point light source.

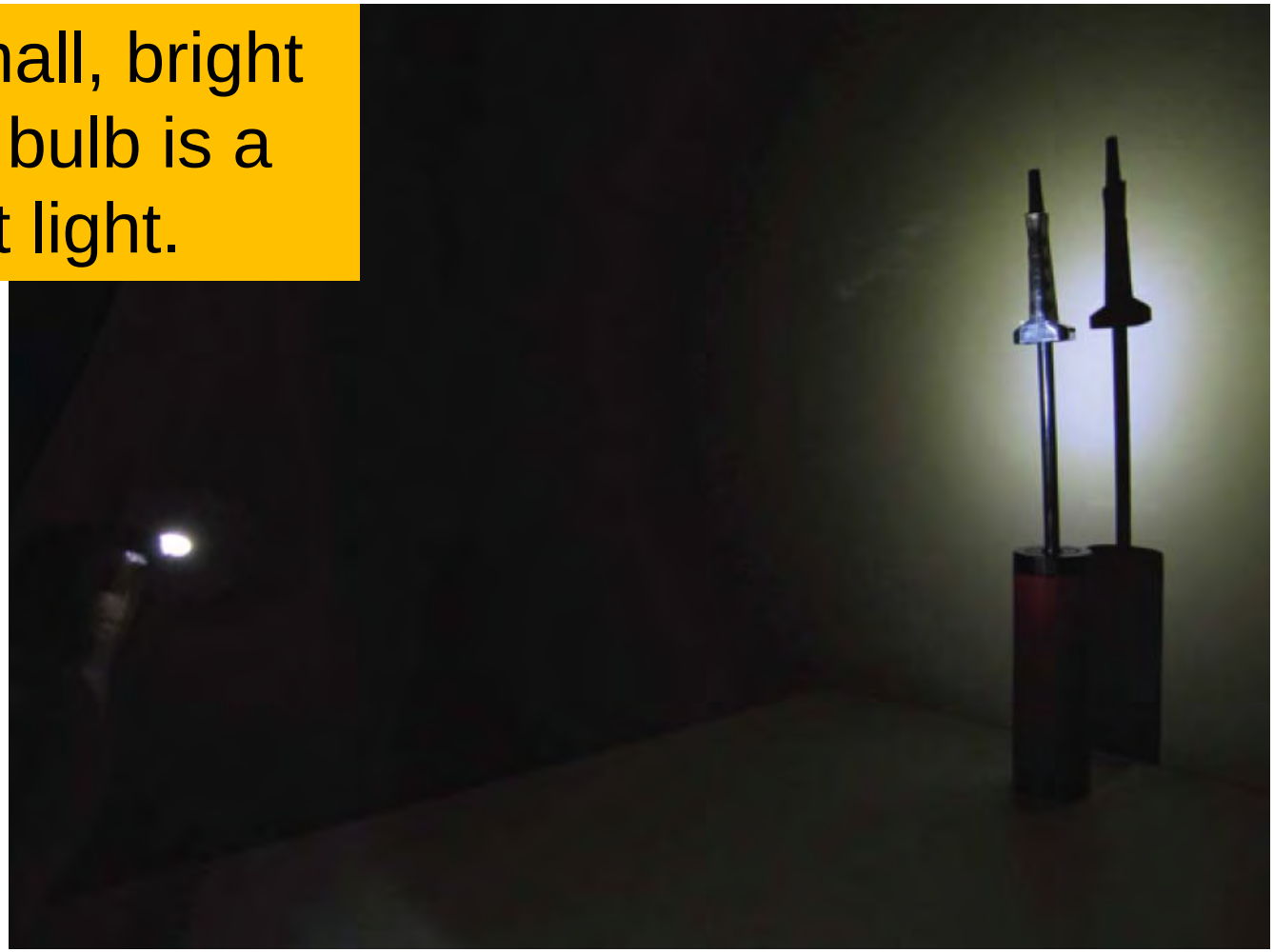


Shadow is sharp (not fuzzy).

Size of the shadow increases as the object gets closer to the light and farther from the wall.

Point Light Example

A small, bright light bulb is a point light.



Film Noir Shadows

Film noir makes extensive use of cast shadows, manipulating their size for dramatic effect.

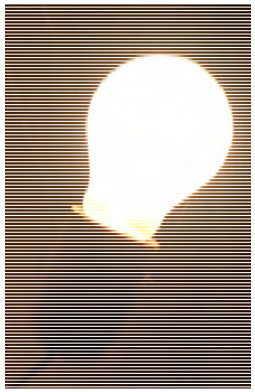
M (1931)

Shadow Of
A Doubt (1943)

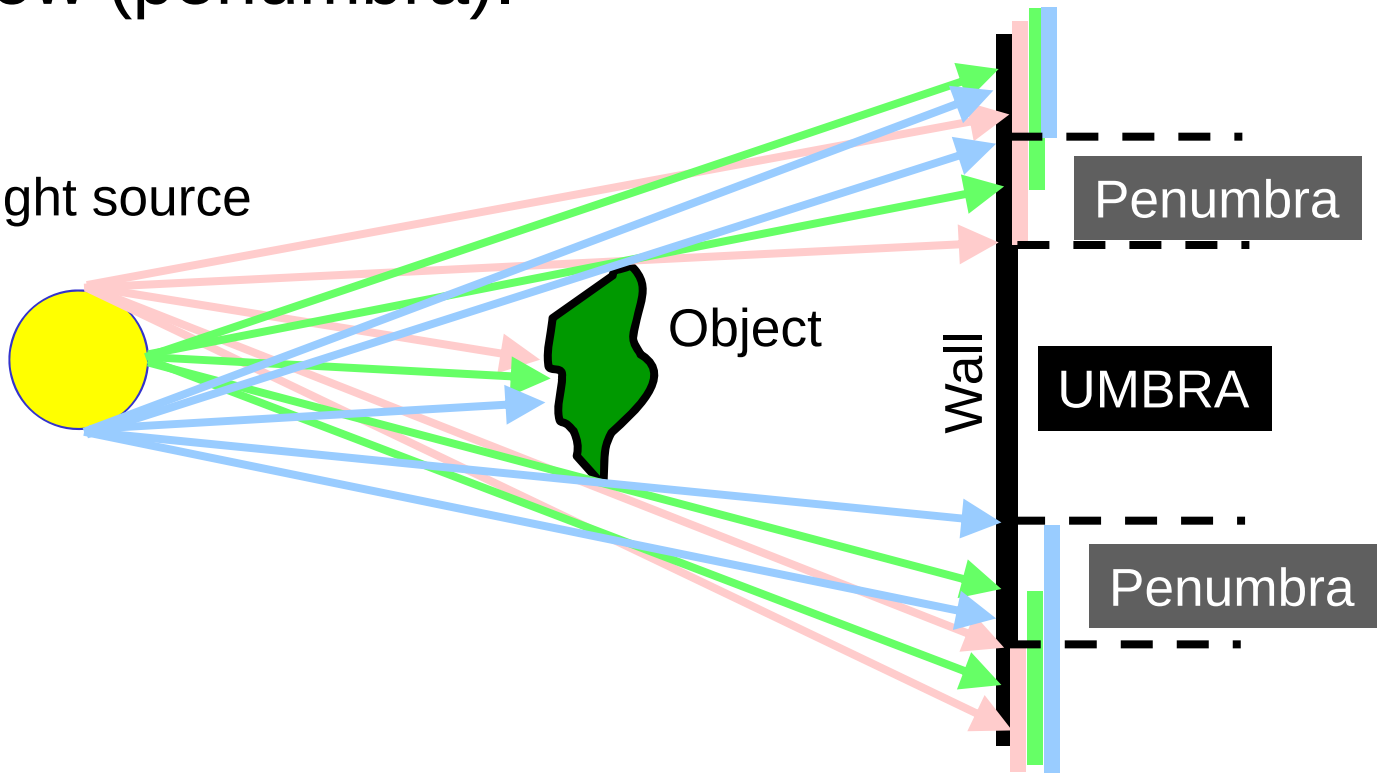
I Confess (1953)

Umbra & Penumbra

Rays from a large light source to the wall show the location of deep shadow (umbra) and fuzzy shadow (penumbra).

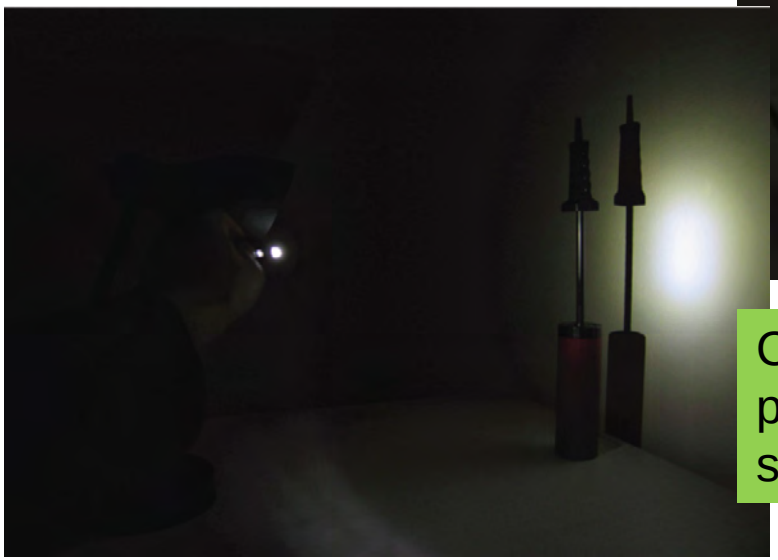


Light Bulb



Umbra & Penumbra

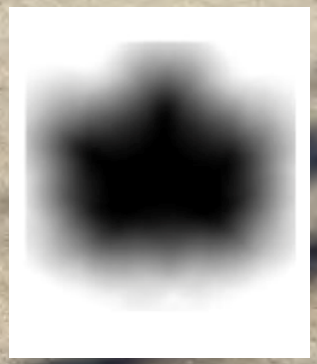
Notice the penumbra in the shadow, especially in the thin neck.



Compare with point light at the same distance.

Solar Shadows

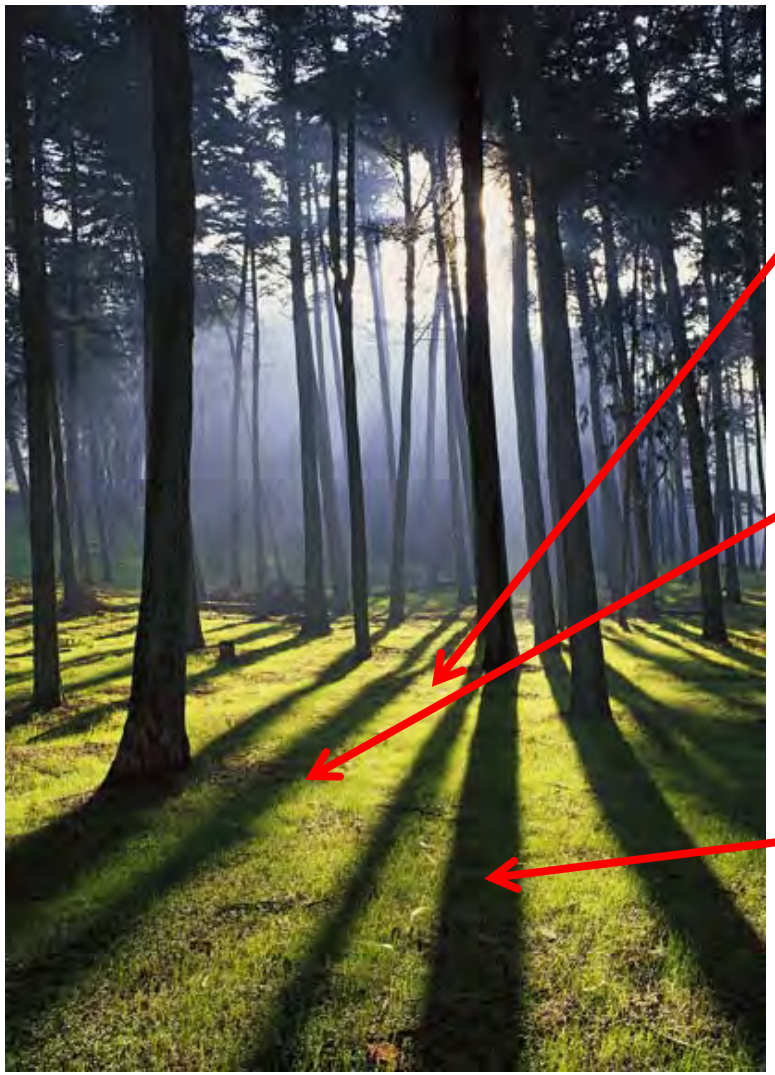
Compare the shadows of leaves high up in the tree with that of a leaf held a few feet above the ground.



Solar Umbra and Penumbra

An ant on the ground standing in the penumbra could see part of the sun.

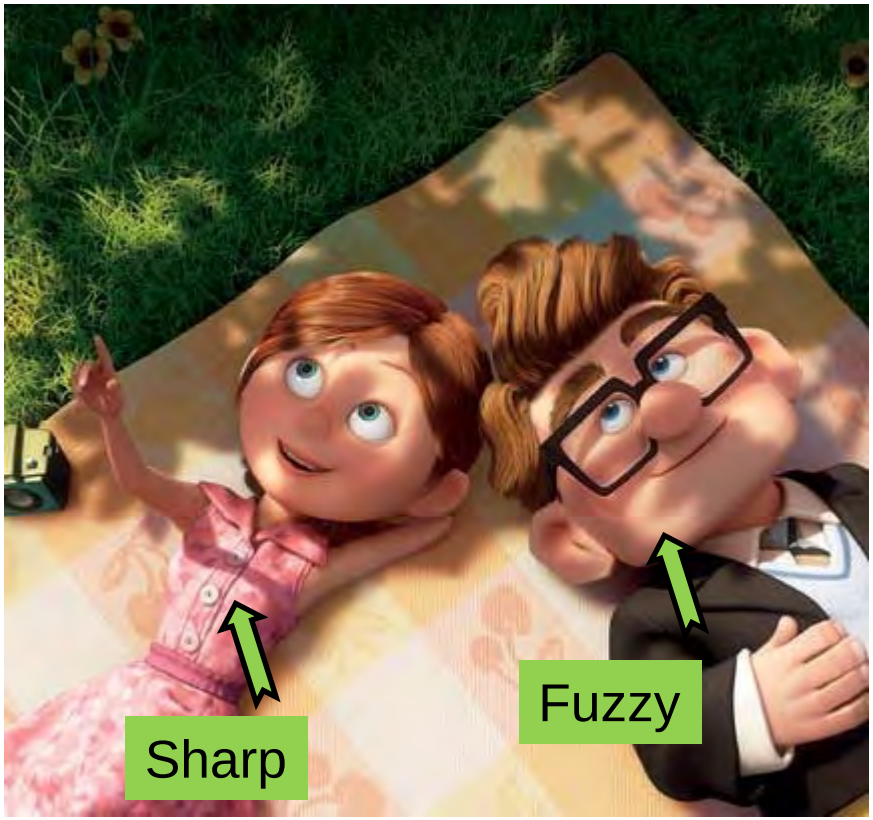
Standing in the umbra part of the shadow, the ant wouldn't see the sun at all.



Penumbra Size

Notice how the cast shadow of Ellie's arm is sharp while the shadows of the leaves of the tree on their faces are fuzzy.

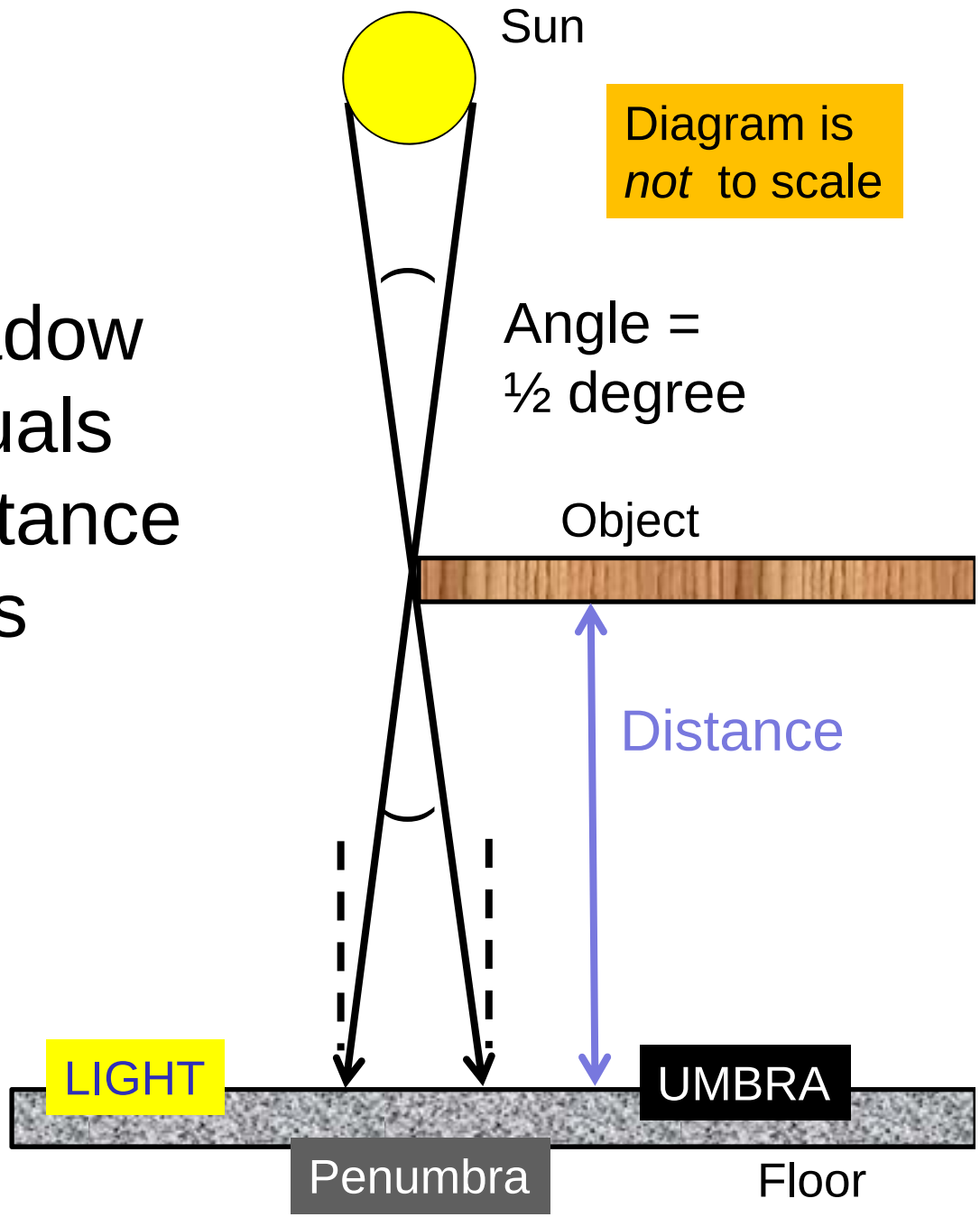
The farther the object is from the light, the wider the penumbra.



Solar Shadows

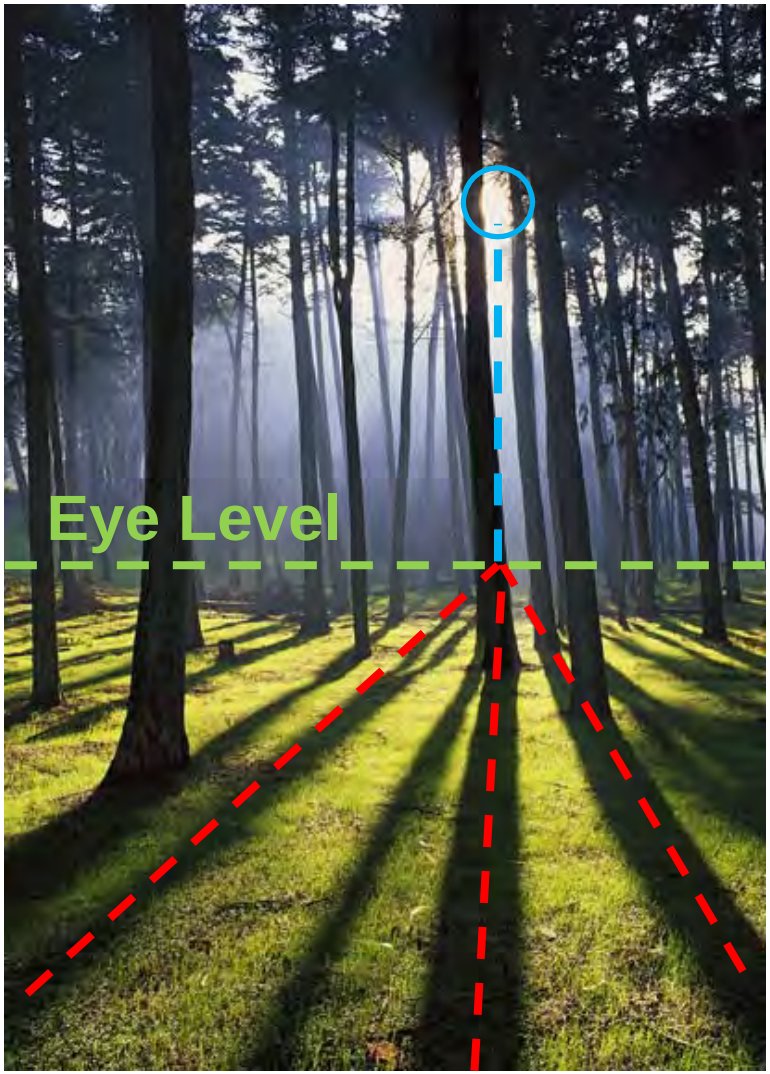
The width of the penumbra for a shadow cast by the Sun equals about 1% of the distance from the object to its shadow.

Example: If an object is 9 feet (108 inches) from the ground, the penumbra is a little more than 1 inch wide.



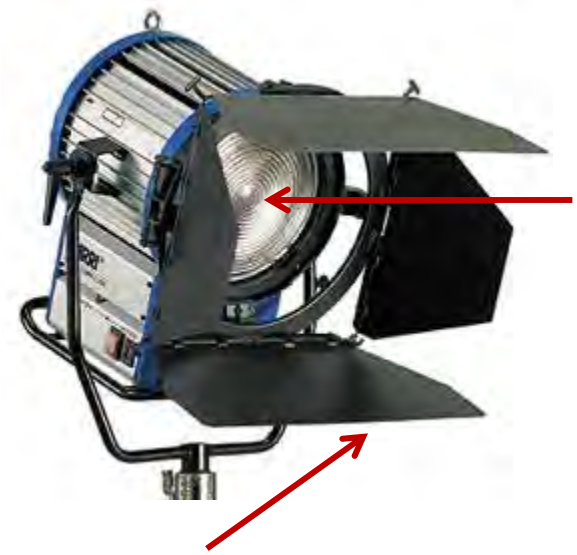
Cast Shadows & Perspective

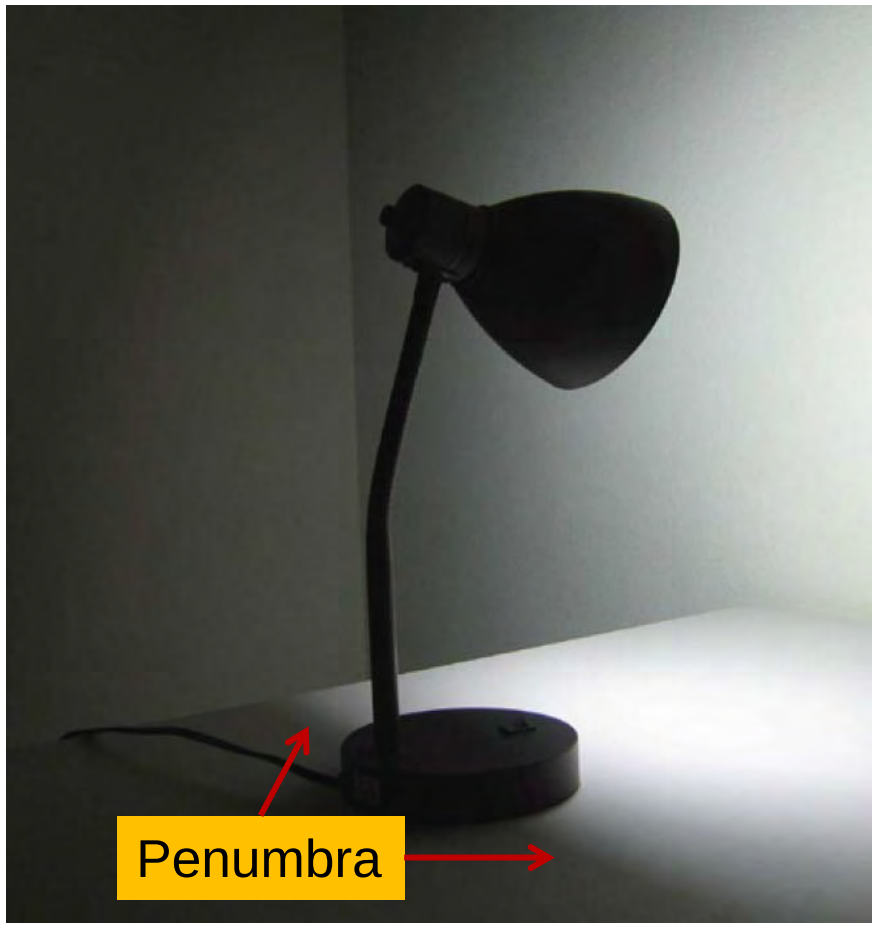
Light from the sun is nearly parallel so the radiating pattern of cast shadows due to perspective.



Spot Lights

If an area light is focused with a lens and/or shielded with an enclosure then the light itself has a penumbra.

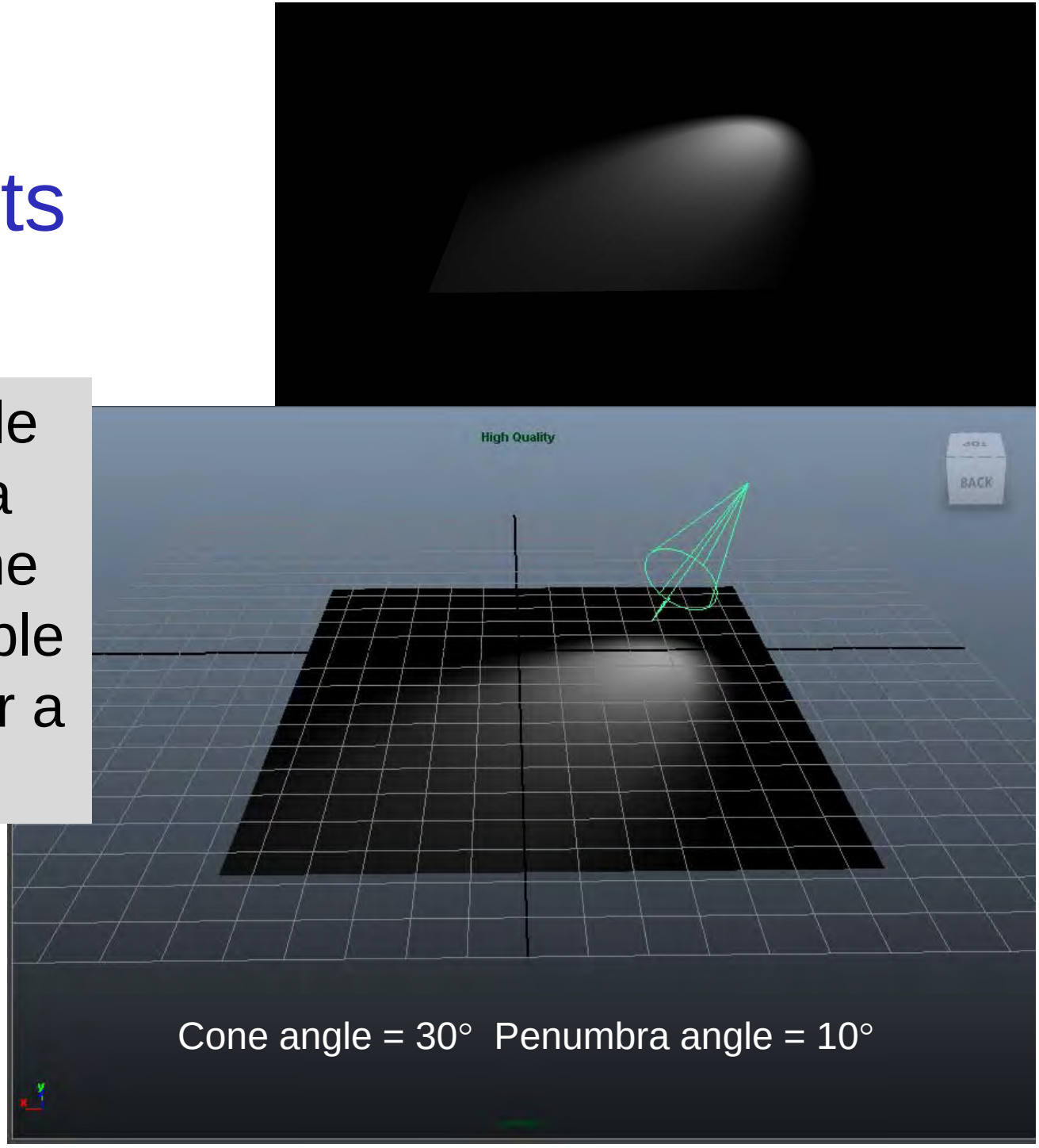




These light sources are **spot lights**

Spot Lights

The cone angle and penumbra angle are some of the adjustable parameters for a CG spot light.



Summary

- Shadows cast only by a directional light source are sharp and dark (pure umbra).
- Shadows cast by a point light source are also umbras but their size changes with the positions of the light, object, and wall.
- In general a shadow has both an umbra and a penumbra (partial shadow).
- Solar shadows have a penumbra.
- Spot lights have a penumbra from the use of lenses and/or enclosures.