

Intro to Lighting



National Science Foundation
WHERE DISCOVERIES BEGIN

Lighting

Lighting is important in all the visual arts, from painting to cinematography.



The Orrery, Joseph Wright (1766)



Humphrey Bogart in *The Maltese Falcon* (1941)

Up (2009)

A great example of how lighting is used in animation is the “Married Life” sequence from Pixar’s *Up*.



Up (2009)



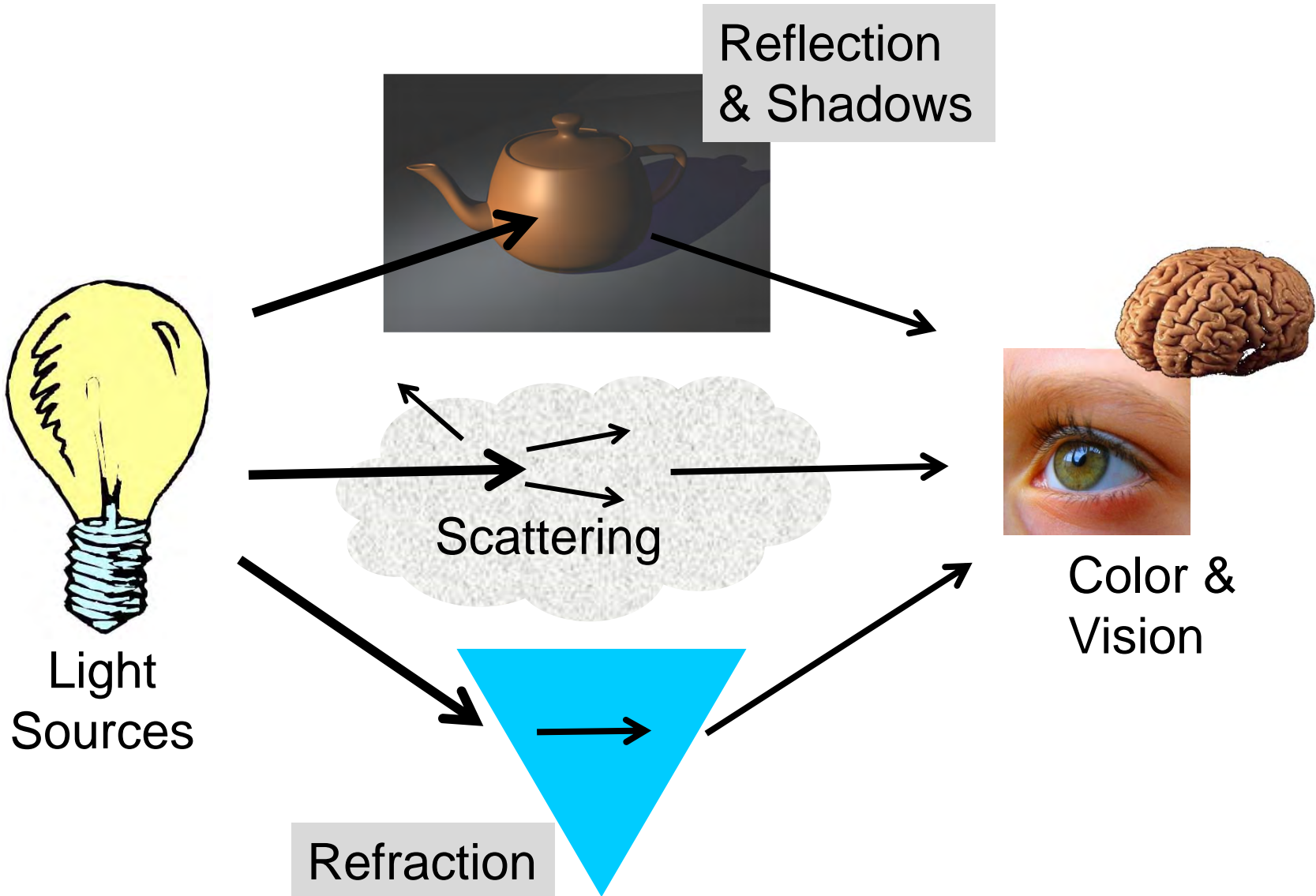
Up (2009)



Up (2009)

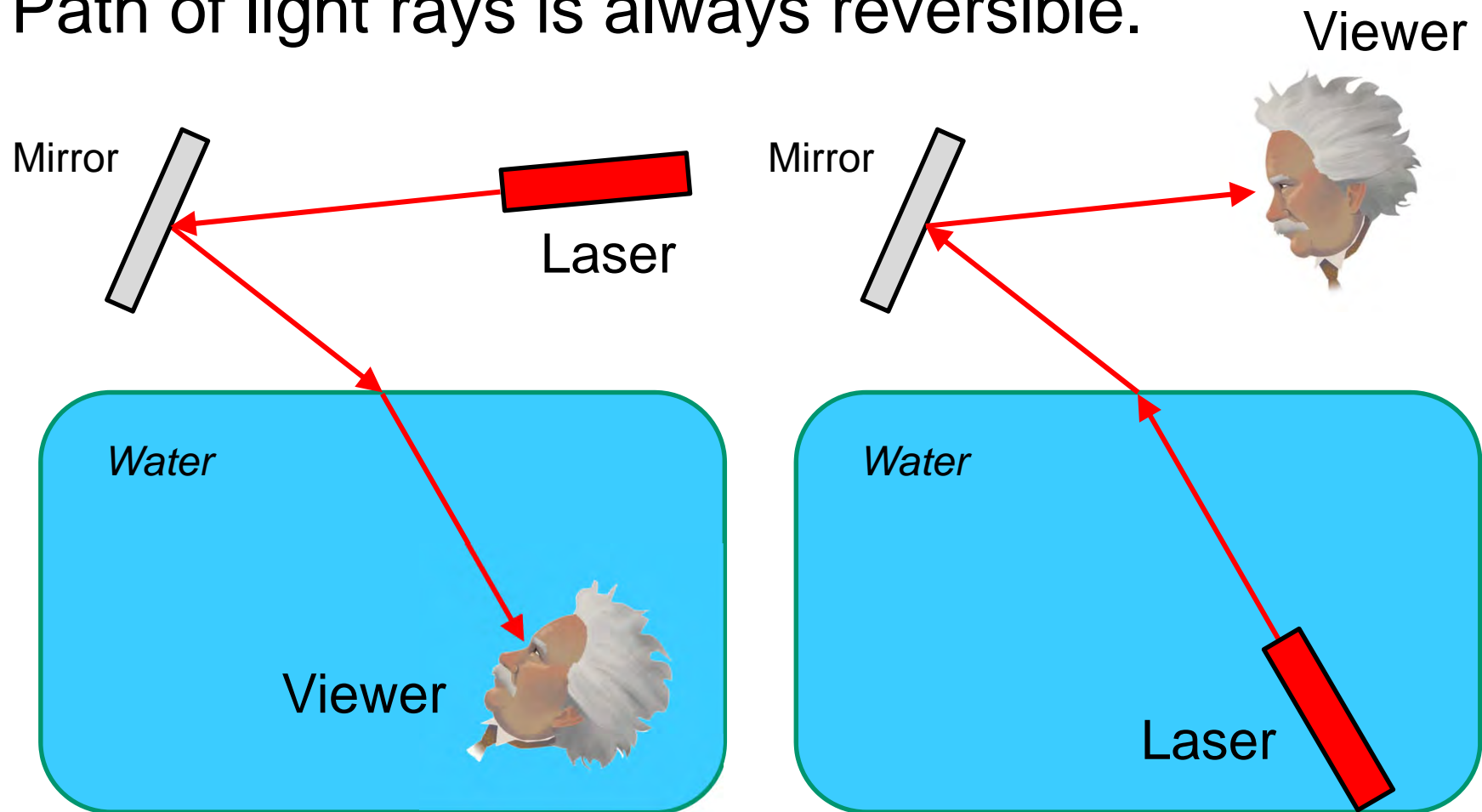


Elements of Optics



Reciprocity

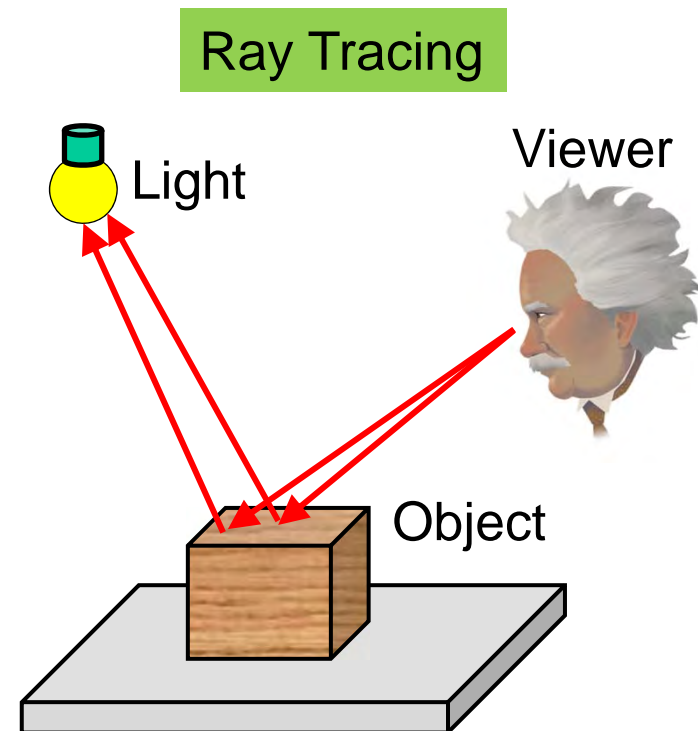
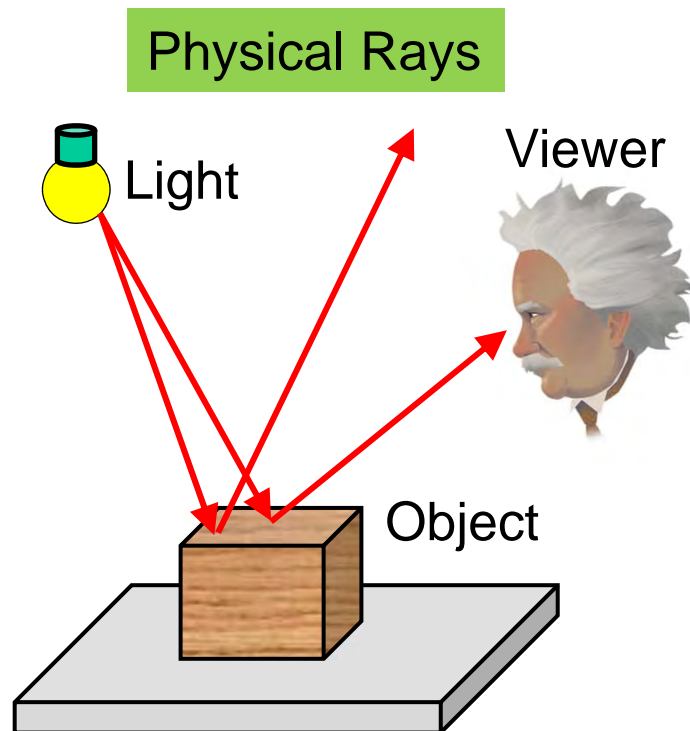
Path of light rays is always reversible.



This symmetry for light rays is called “reciprocity.”

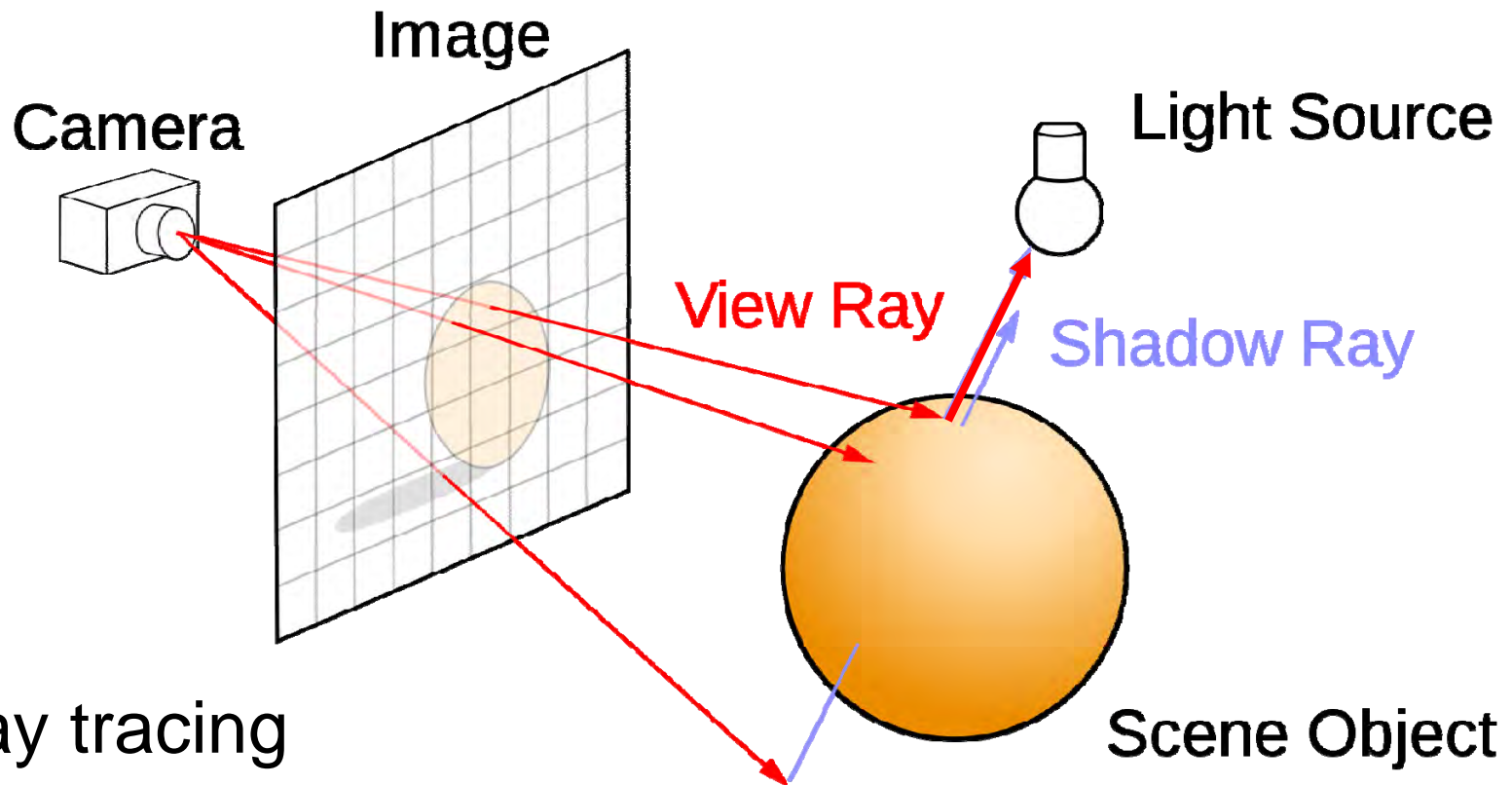
Physical Rays & Ray Tracing

Physical rays are from source to viewer (camera).
Ray tracing uses rays from viewer to source.



Ray tracing only calculates rays that reach the viewer.

Ray Tracing Algorithm

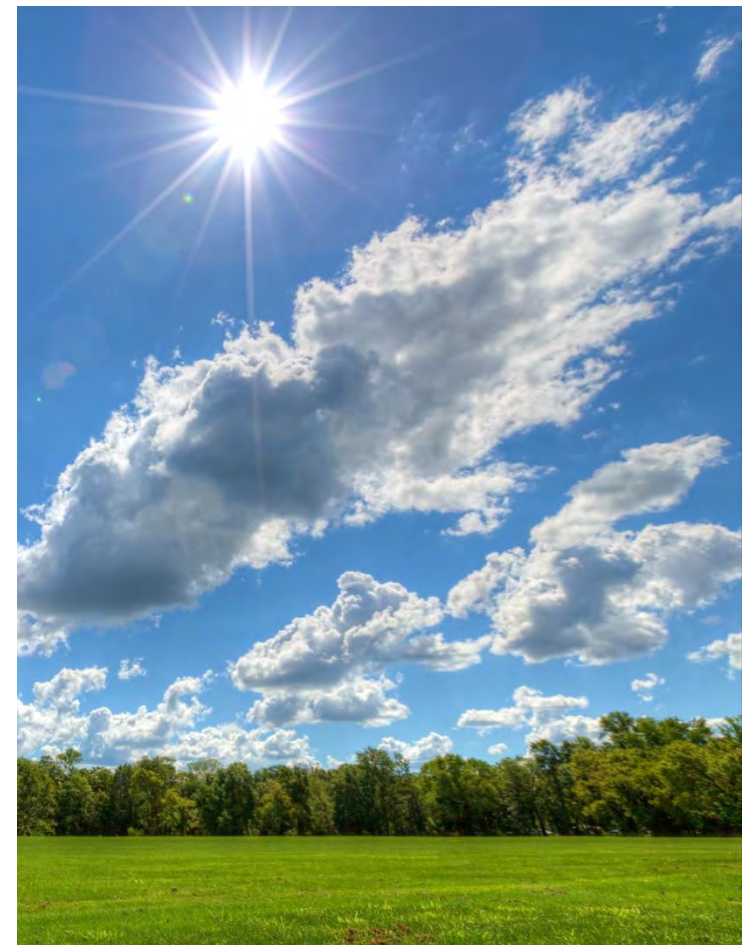
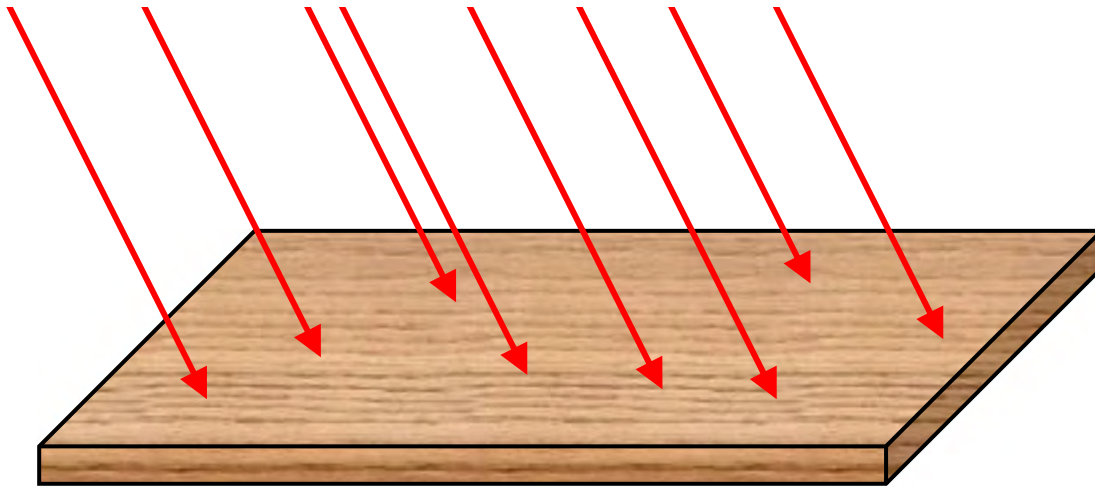


The ray tracing algorithm in computer graphics uses reciprocity.

Directional Light Sources

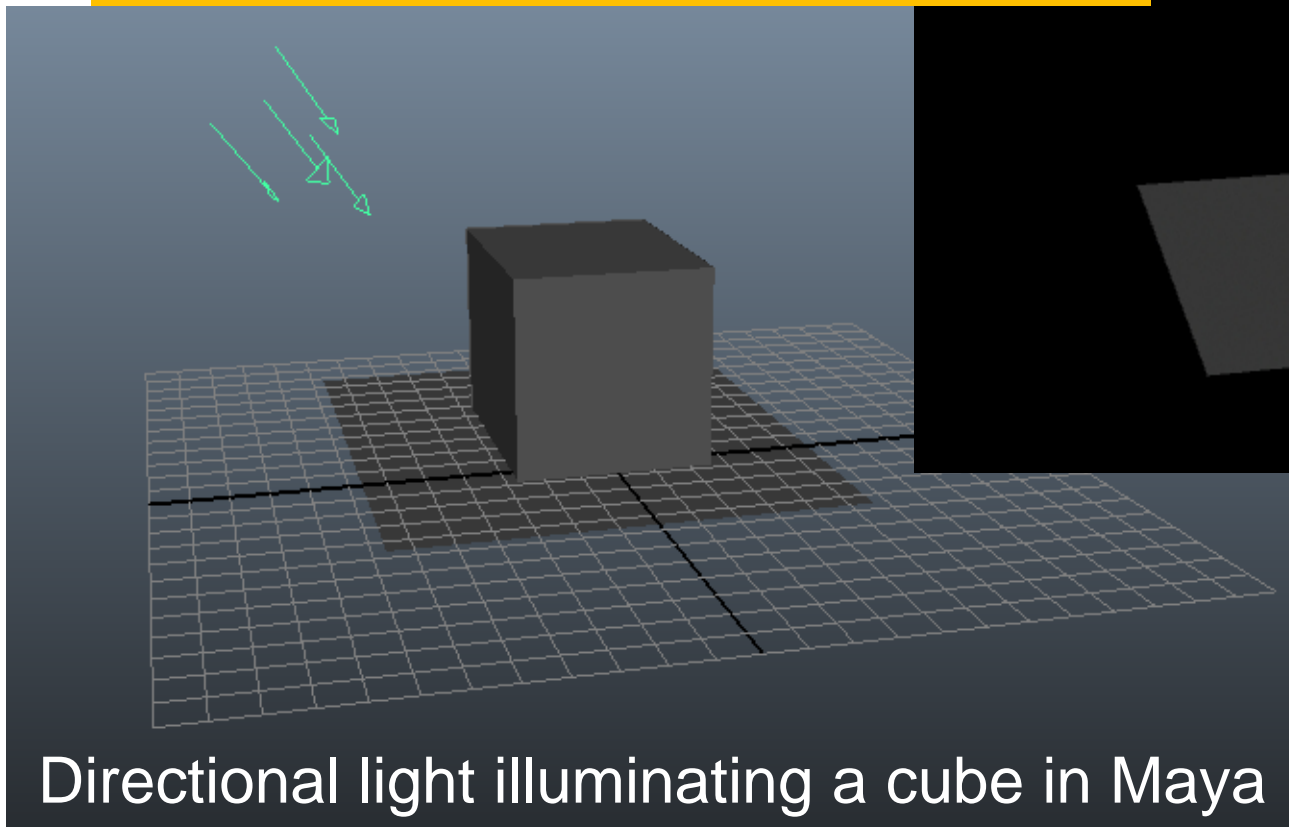
A directional light source produces parallel light rays.

The Sun is (roughly) a directional light source.

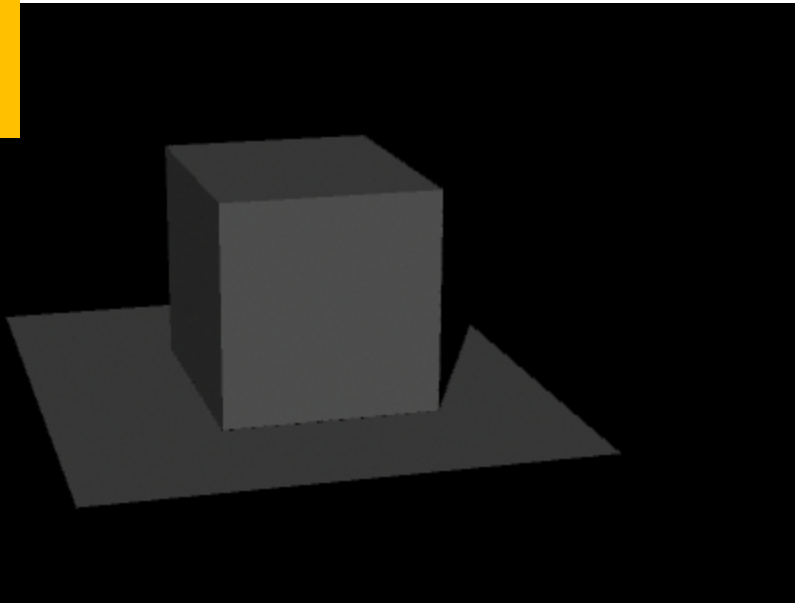


Directional Light Sources

Different faces have different brightness due to the angle between surface and the light.



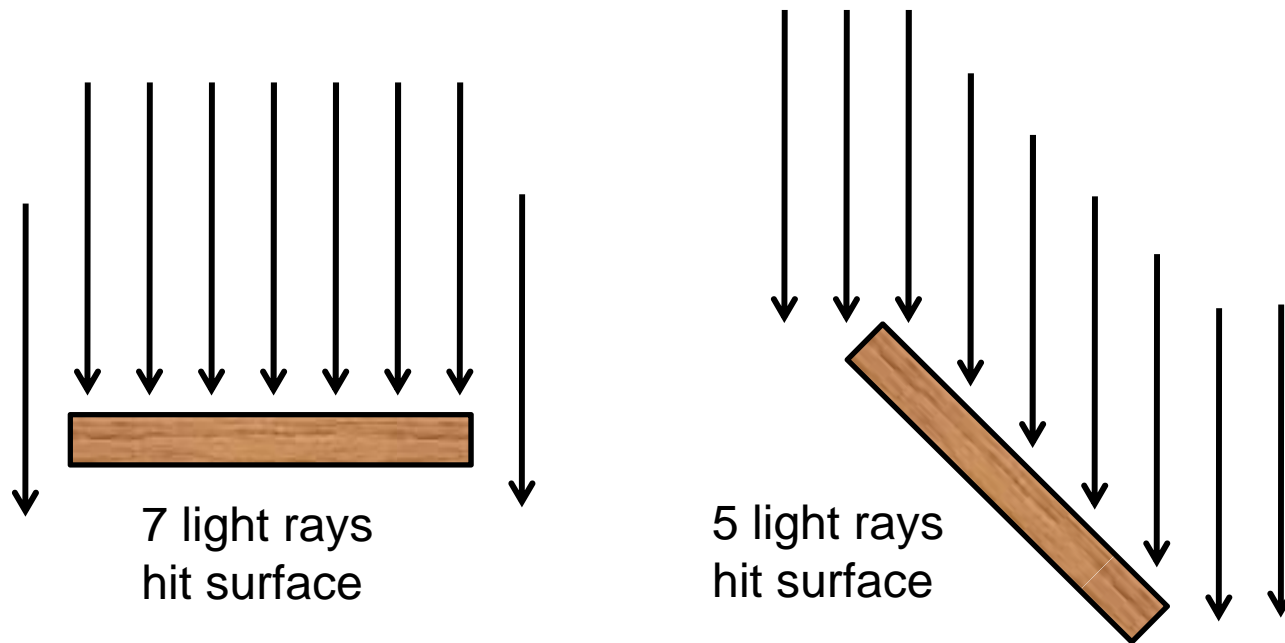
Directional light illuminating a cube in Maya



Top of the cube and the floor have the same brightness.

Light Intensity & Angle

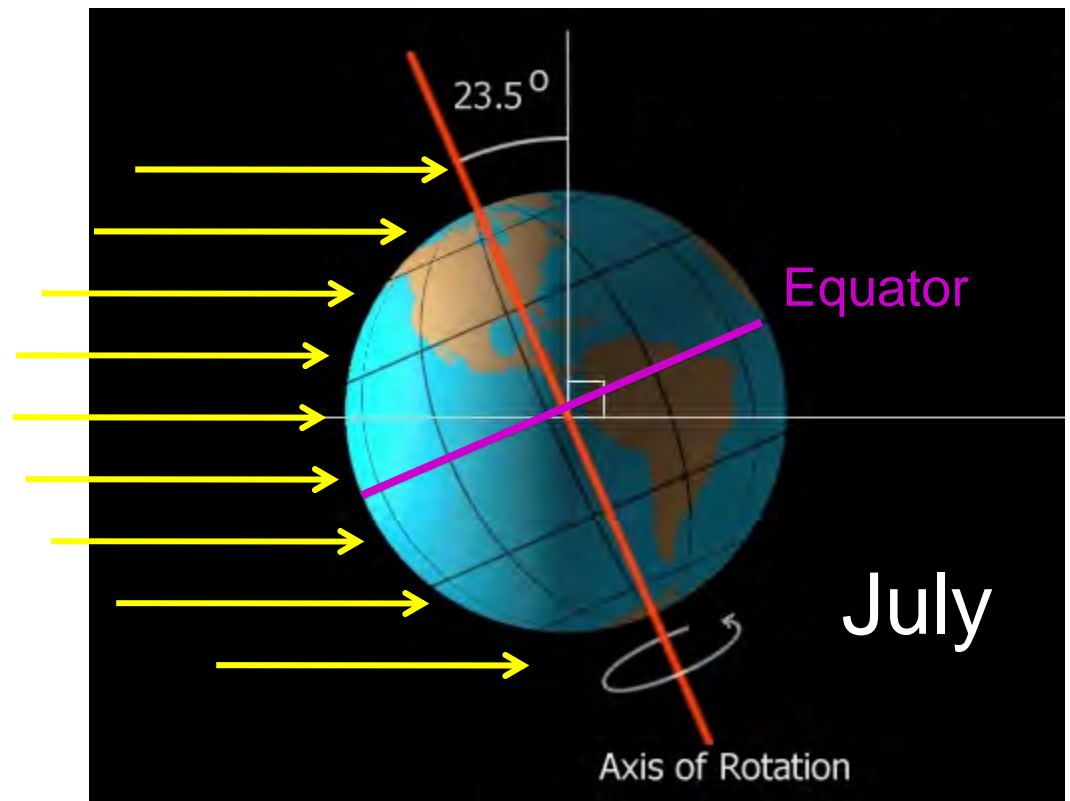
When the surface is tilted, the intensity of the light on the surface decreases because the rays are spread over a larger area.



Seasons of the Year

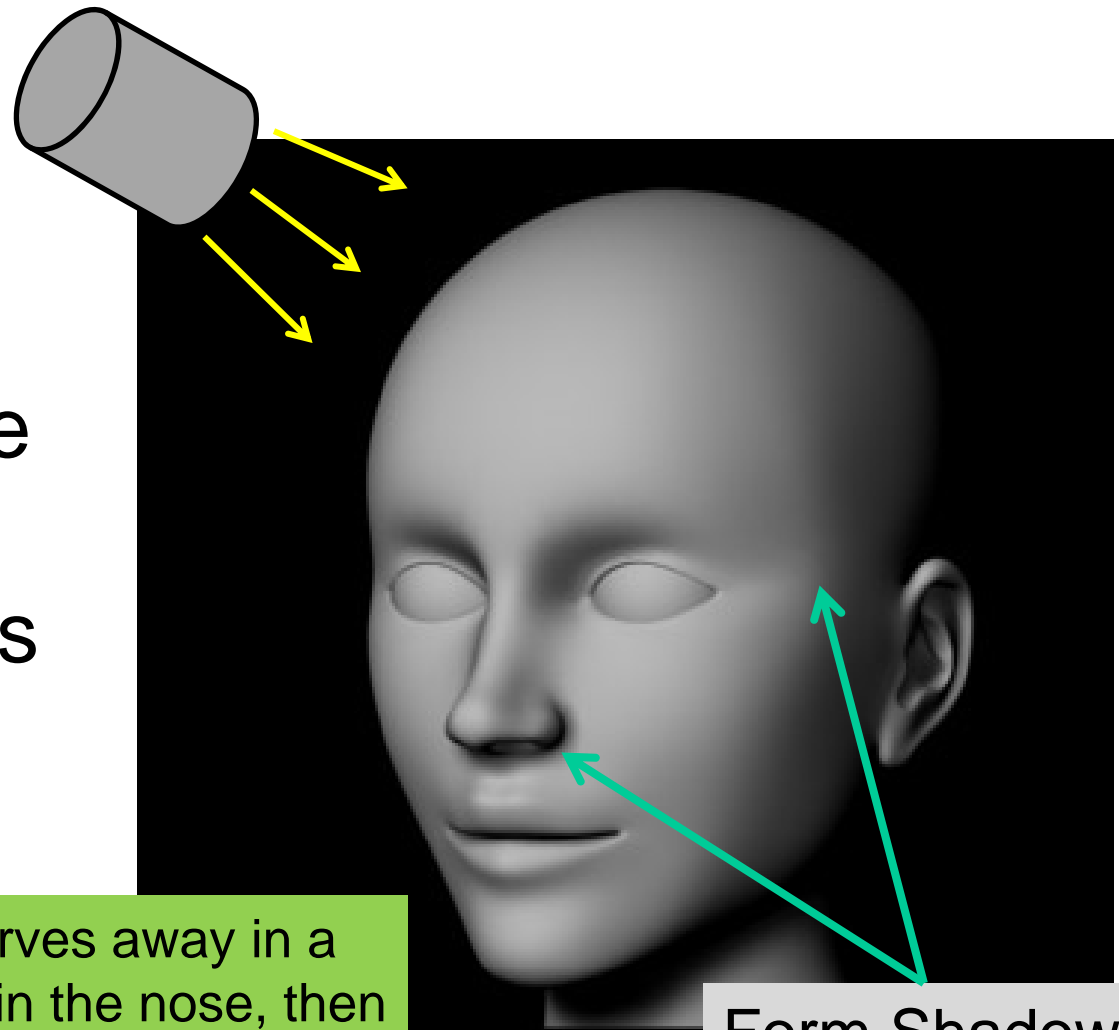
Northern Hemisphere is warm in July because Earth is tilted towards the Sun.

Earth is slightly farther from the Sun in July.



Lighting and Dimension

Intensity of light striking a surface varying with angle is a strong visual cue for an object's curvature and shape.



If the form curves away in a tight turn, as in the nose, then the form shadow is sharp.

Form Shadow

Key Lighting (One-Point)

Simplest type of lighting is with a single dominant light source, called the *key light*.

Traditionally, the light source is located on the left side of the scene.

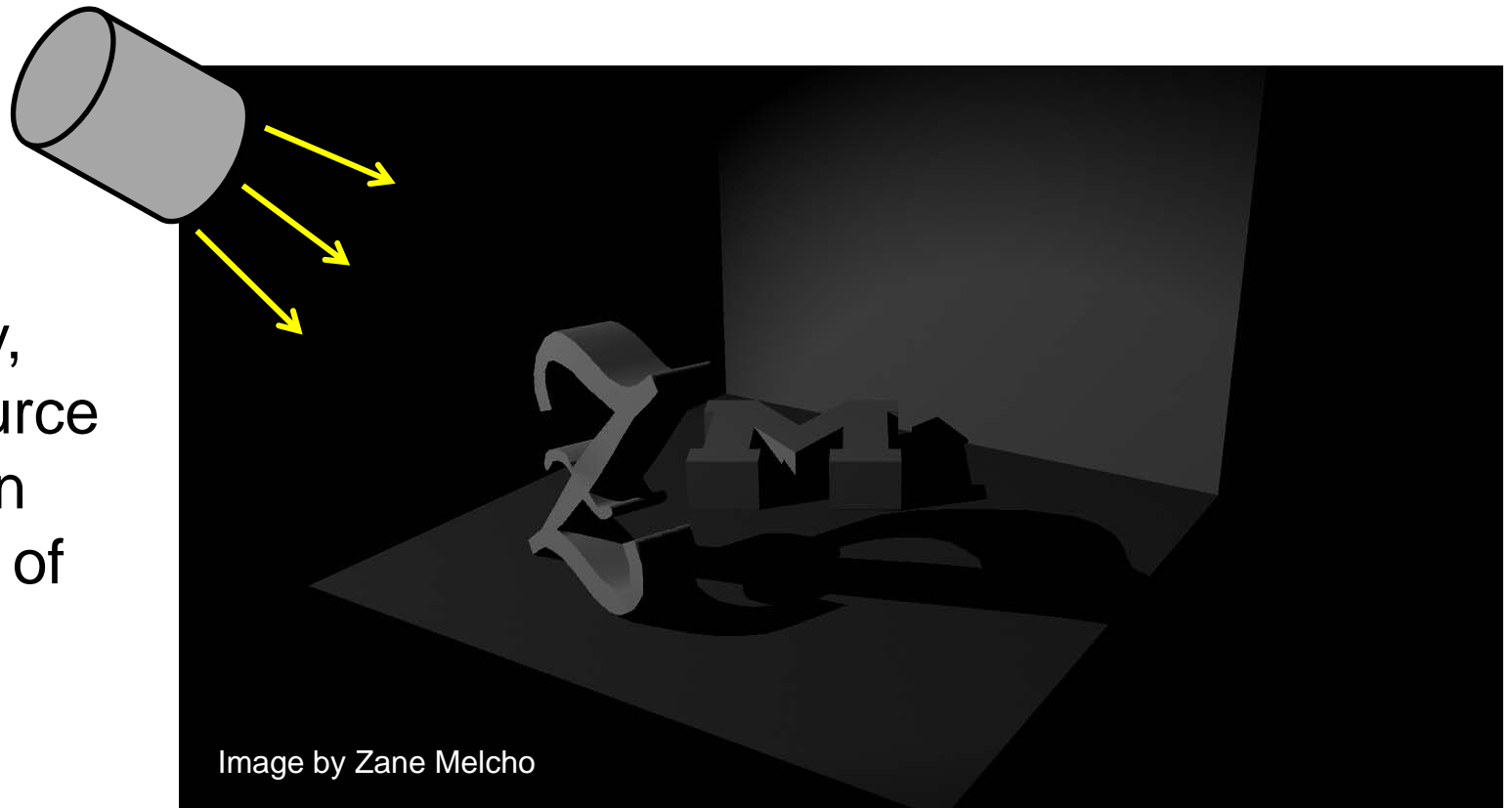
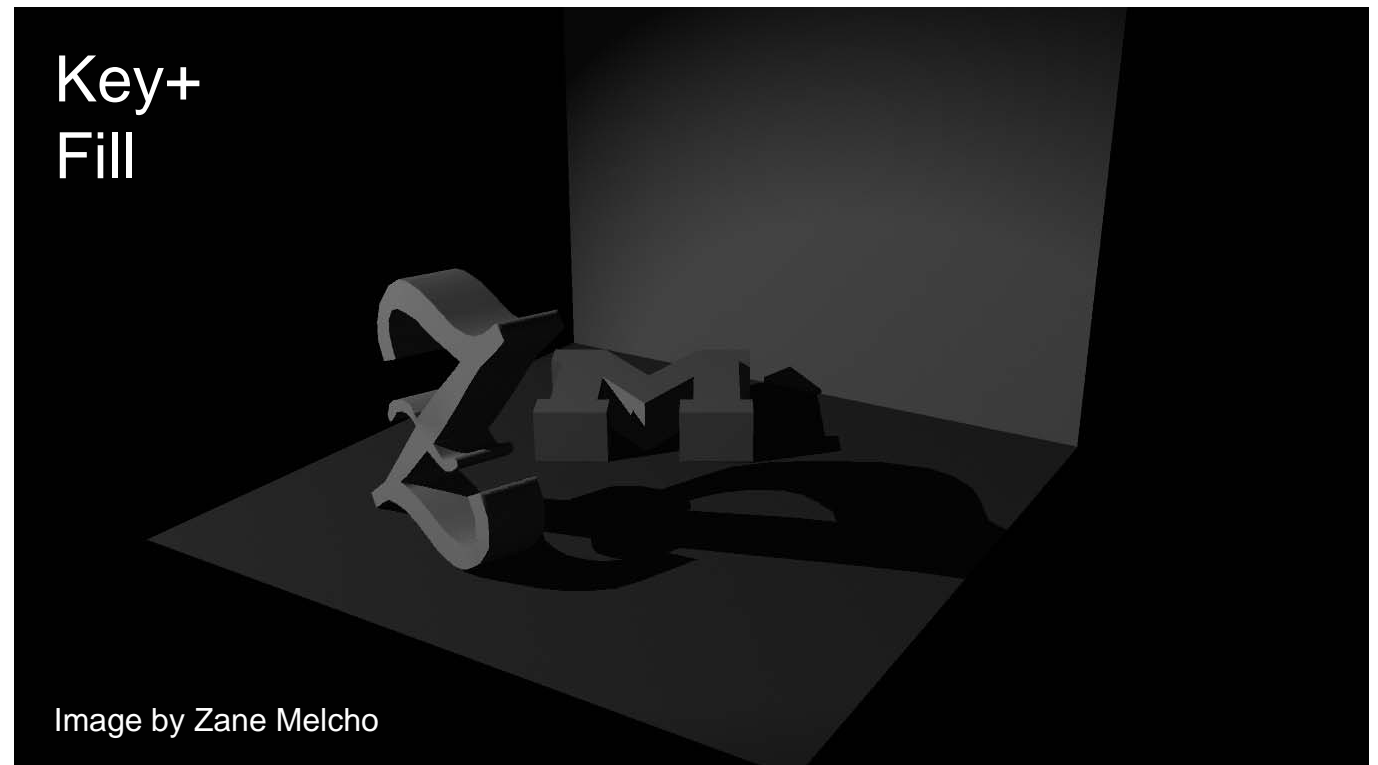
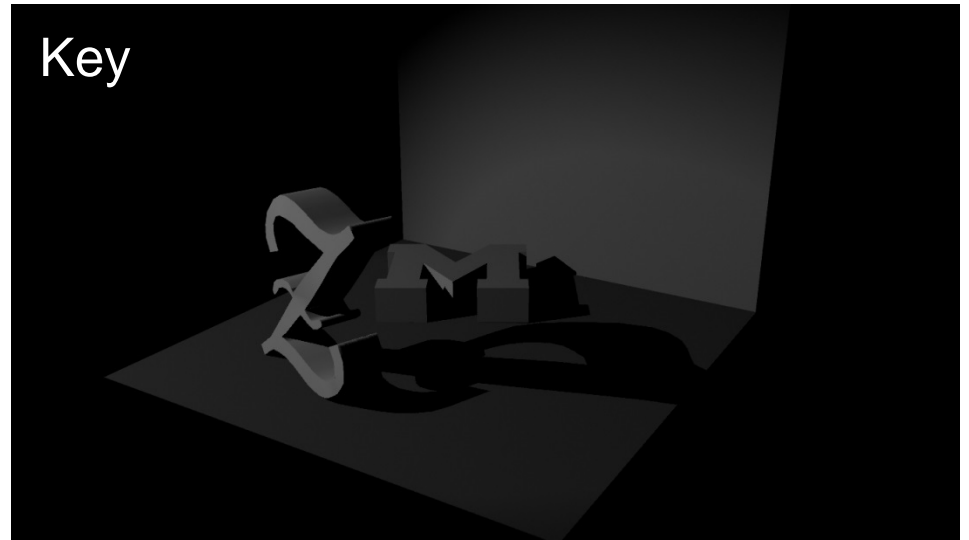


Image by Zane Melcho

Fill Lighting

With two-point lighting a *fill light* softens the contrast by adding ambient light.

Note: The key and fill light may each come from multiple light sources.



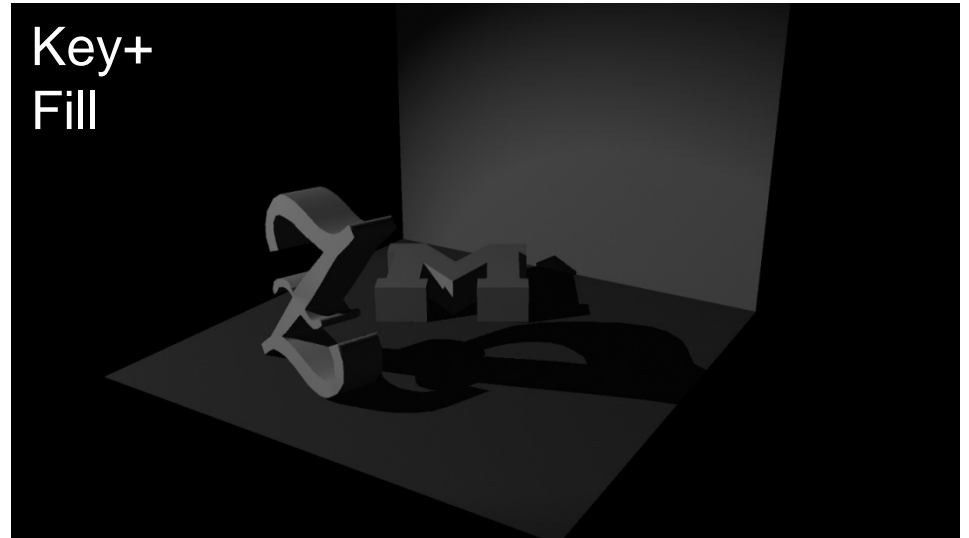
Rim Lighting

Adding a rim light creates contrast at edges that are otherwise lost in shadow.

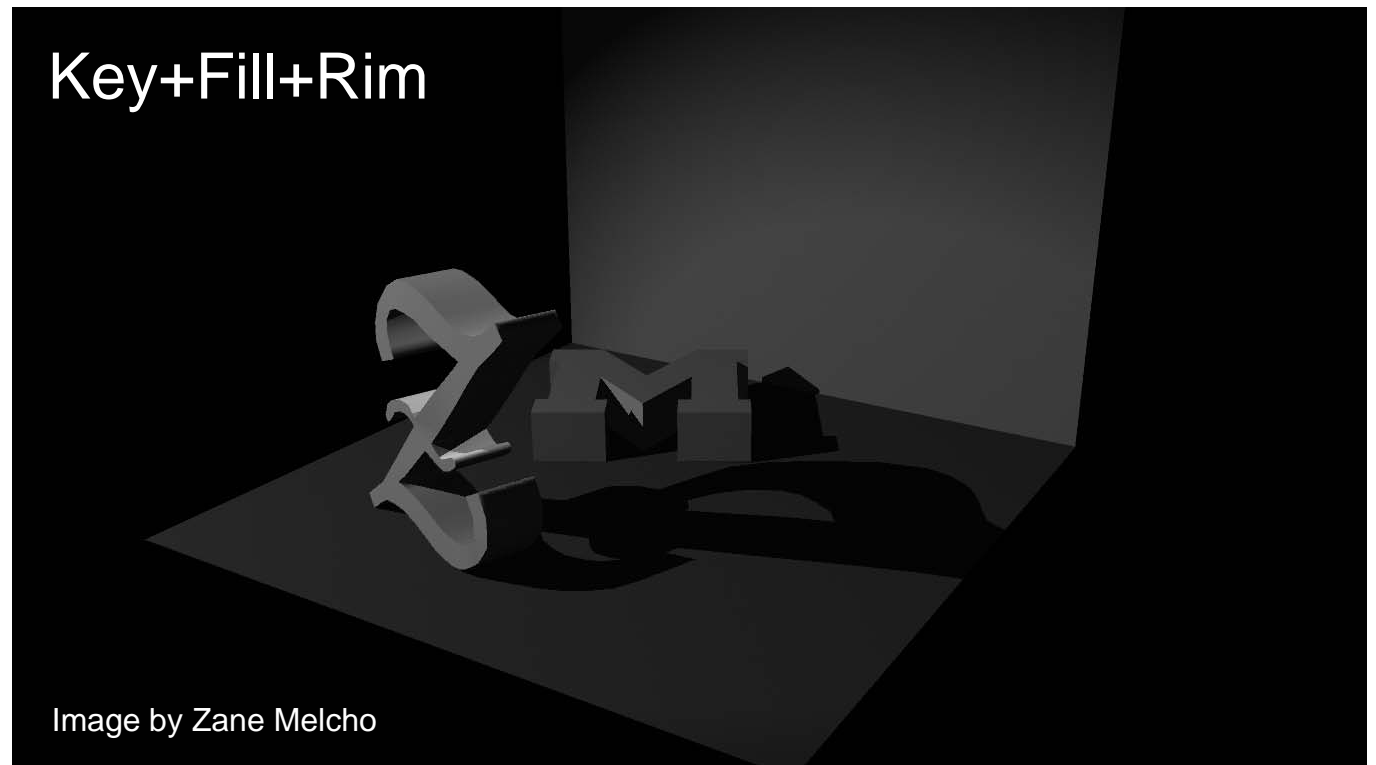
A rim light is also called a kicker or a back light.

In close-up shots it is used to accent hair.

Key+
Fill



Key+Fill+Rim



Three-point Lighting

Three-point lighting (Key, Fill, and Rim) is a formula that Hollywood has used for years.



Three-point lighting usually looks good but sometimes too good, that is, it seems fake.

From *Casablanca* (1942)

Summary

- Physical light rays travel from the light source to the viewer/camera.
- By reciprocity, we may trace rays from the camera back to the light source.
- Directional light source has parallel rays.
- Light intensity decreases as a surface turns away from the light source.
- Three point lighting combines key, fill, and rim lights to provide the main, ambient, and accent lighting in a scene.