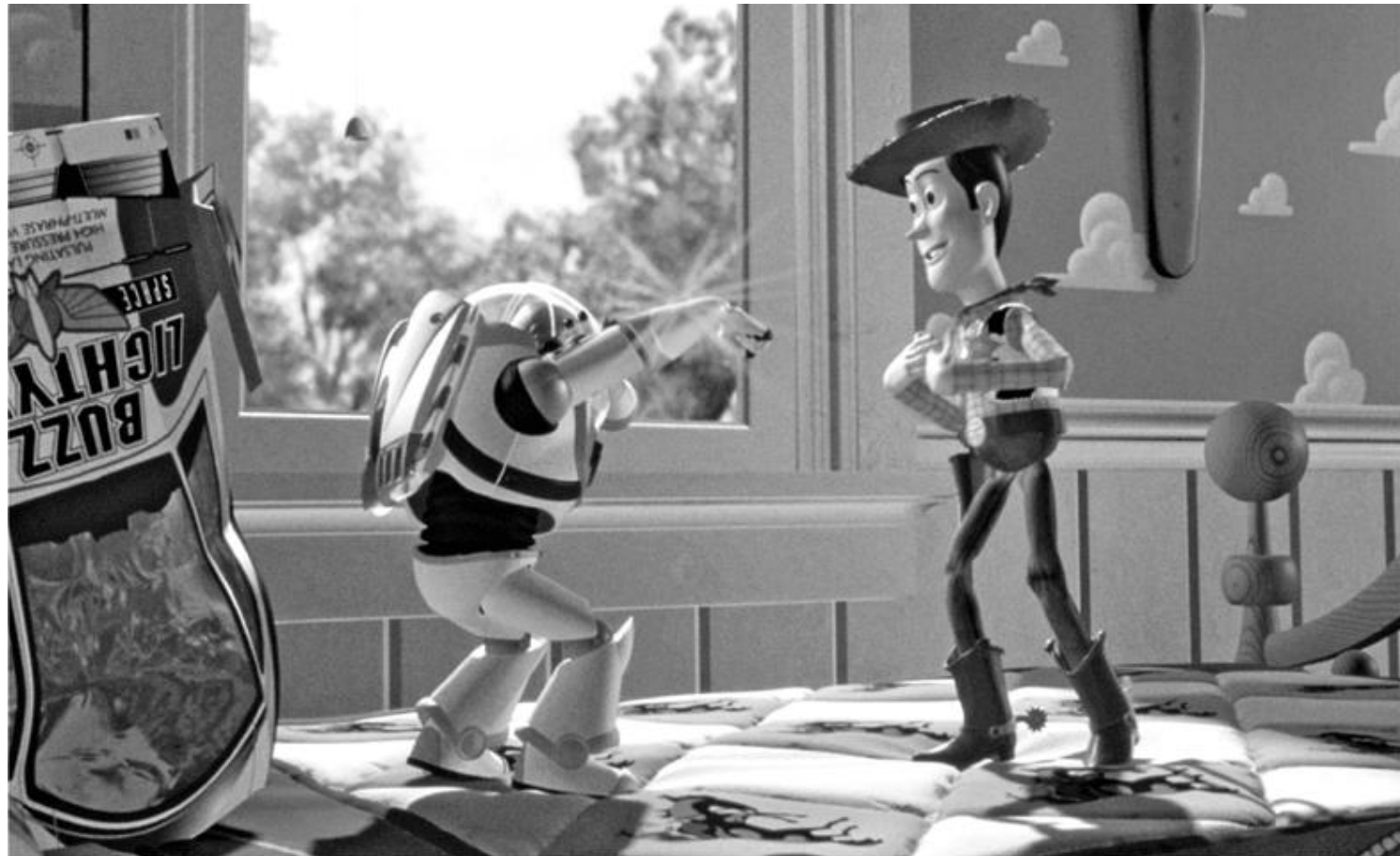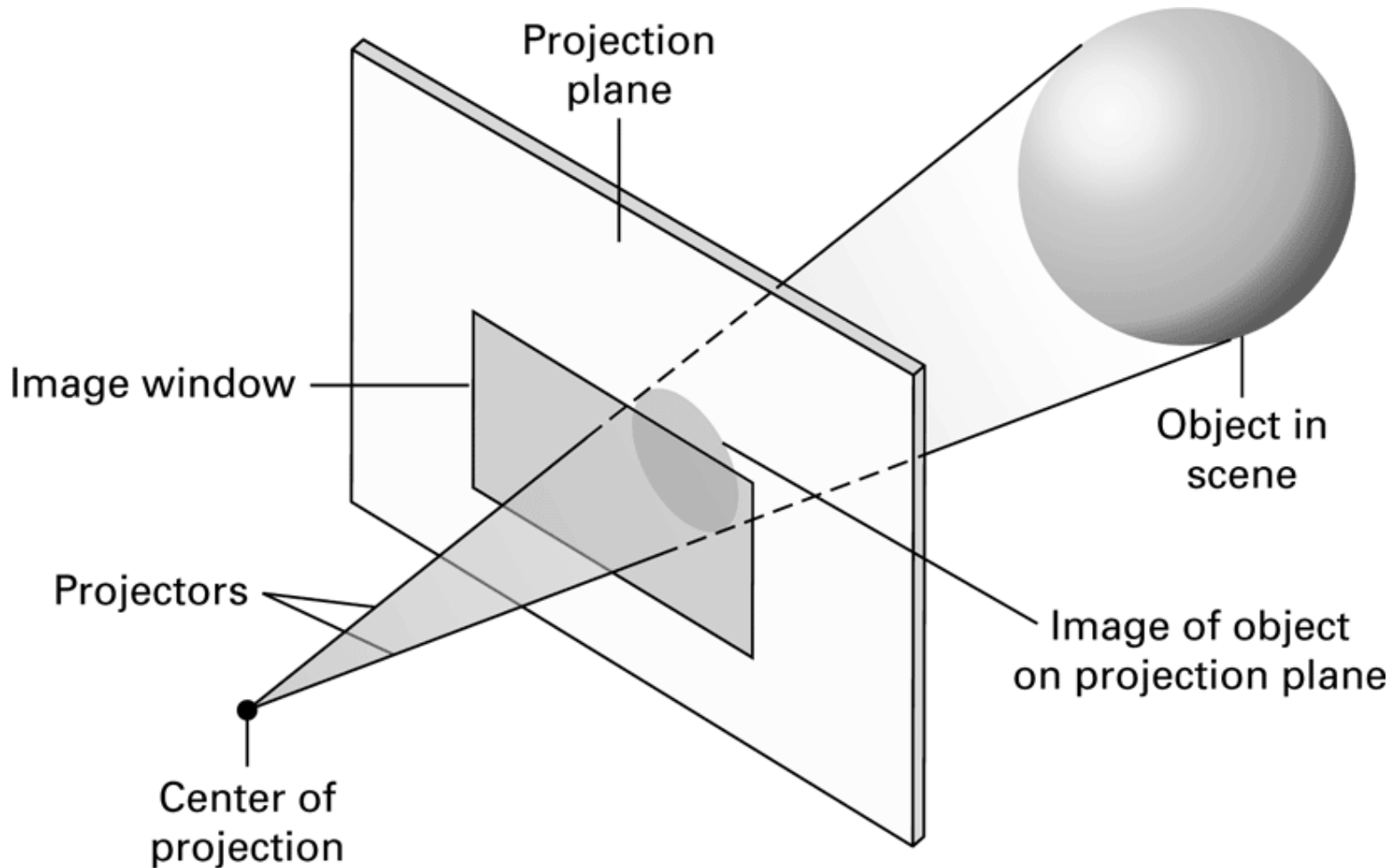# 2D Versus 3D Graphics

- **2D Graphics:** Deals with manipulating two-dimensional images

- **3D Graphics:** Deals with producing and displaying images of three-dimensional virtual scenes.

Figure 10.1 A "photograph" of a virtual world produced using 3D graphics (from Toy Story by Walt Disney Pictures/Pixar Animation Studios) © Corbis/Sygma

Figure 10.2 The 3D graphics paradigm

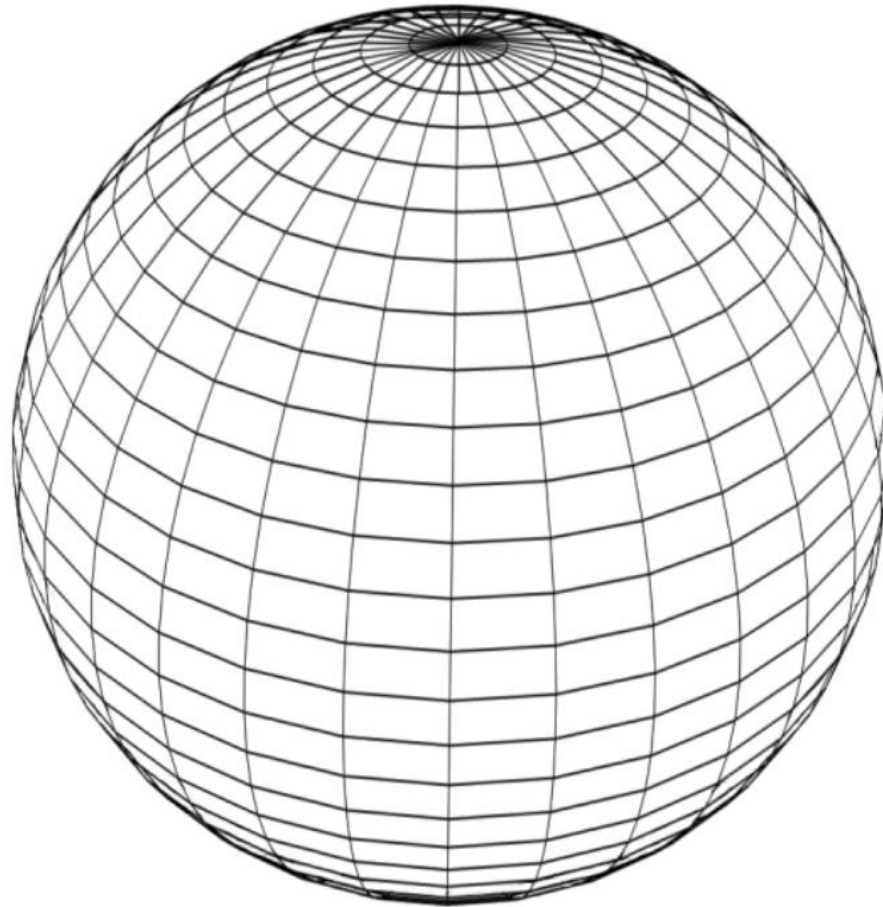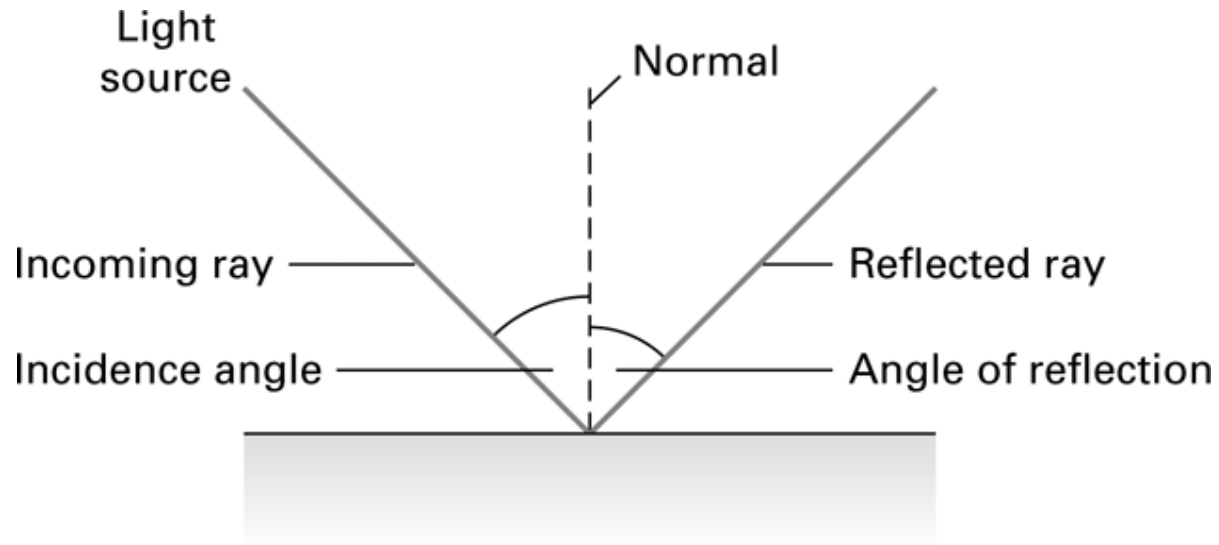# Figure 10.3 A polygonal mesh for a sphere

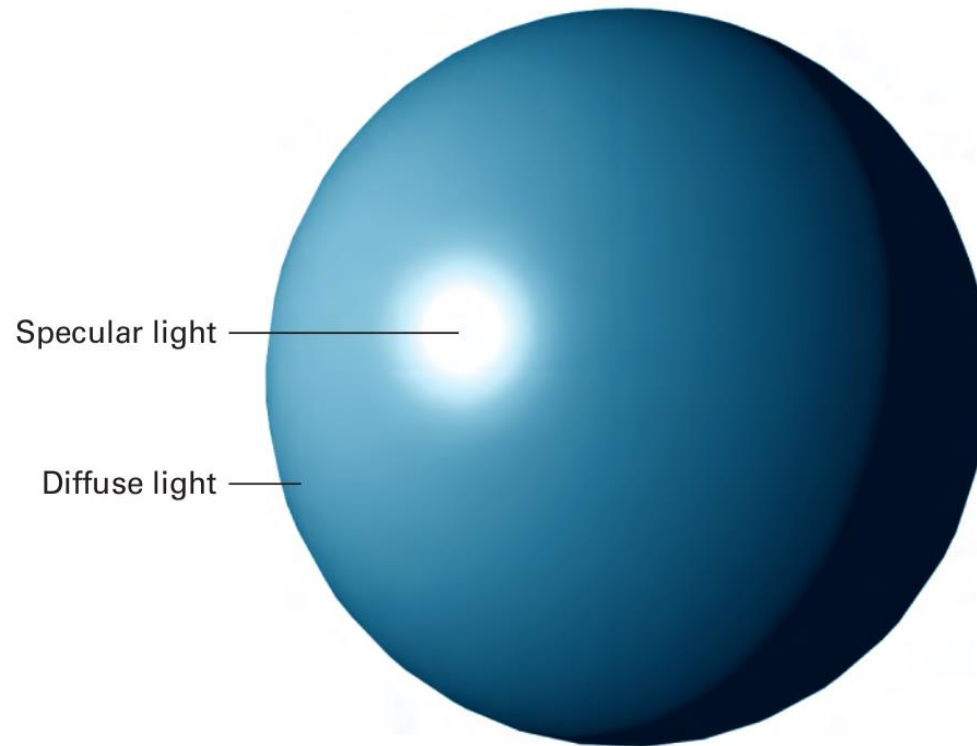# Figure 10.6 A scene from Shrek 2 by Dreamworks SKG (© Dreamworks/The Kobal Collection)

Reflection Versus Refraction

- Reflection: Light rays bounce off surface.
  - Specular light
  - Diffuse light
  - Ambient light

- Refraction: Light rays penetrate surface.

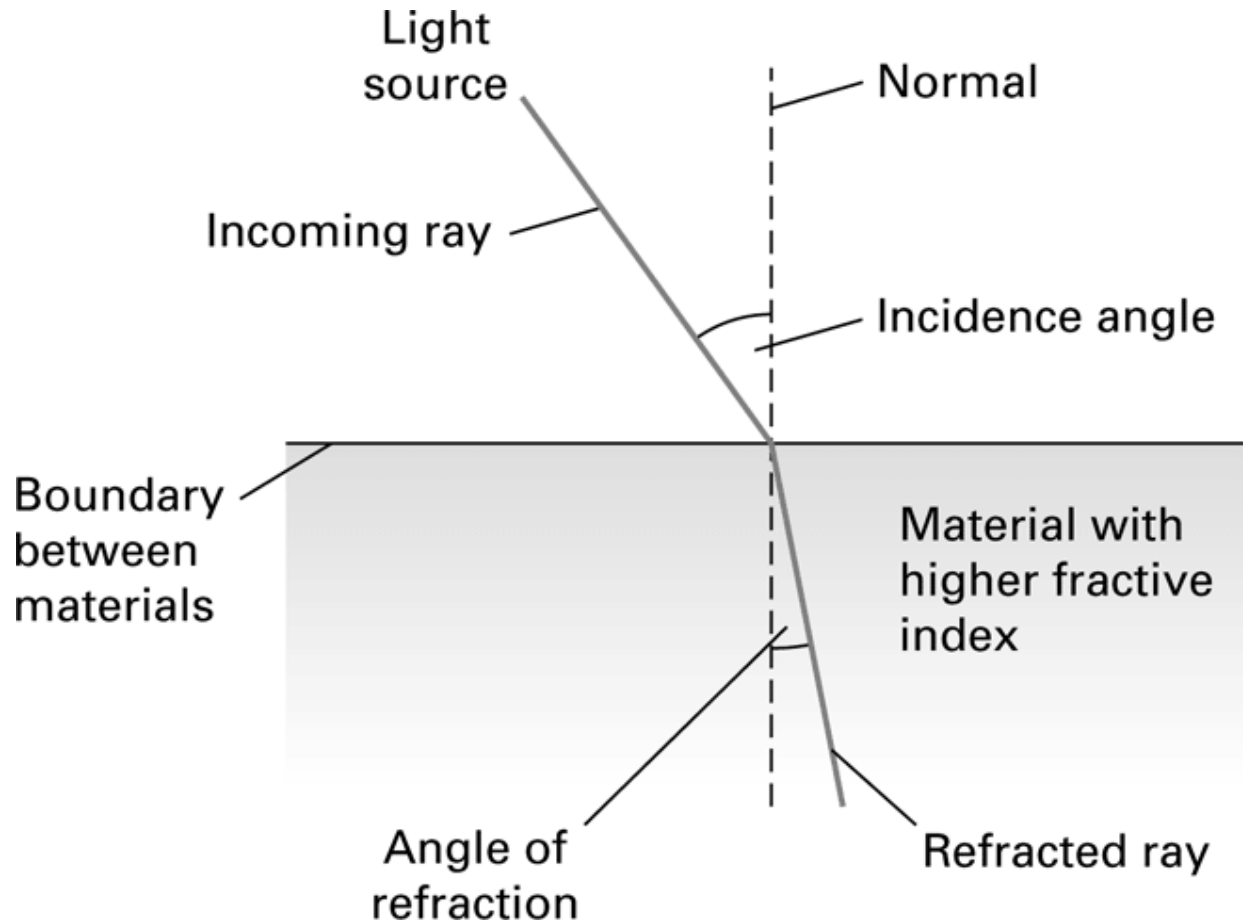# Figure 10.7 Reflected light

Figure 10.8 Specular versus diffuse light
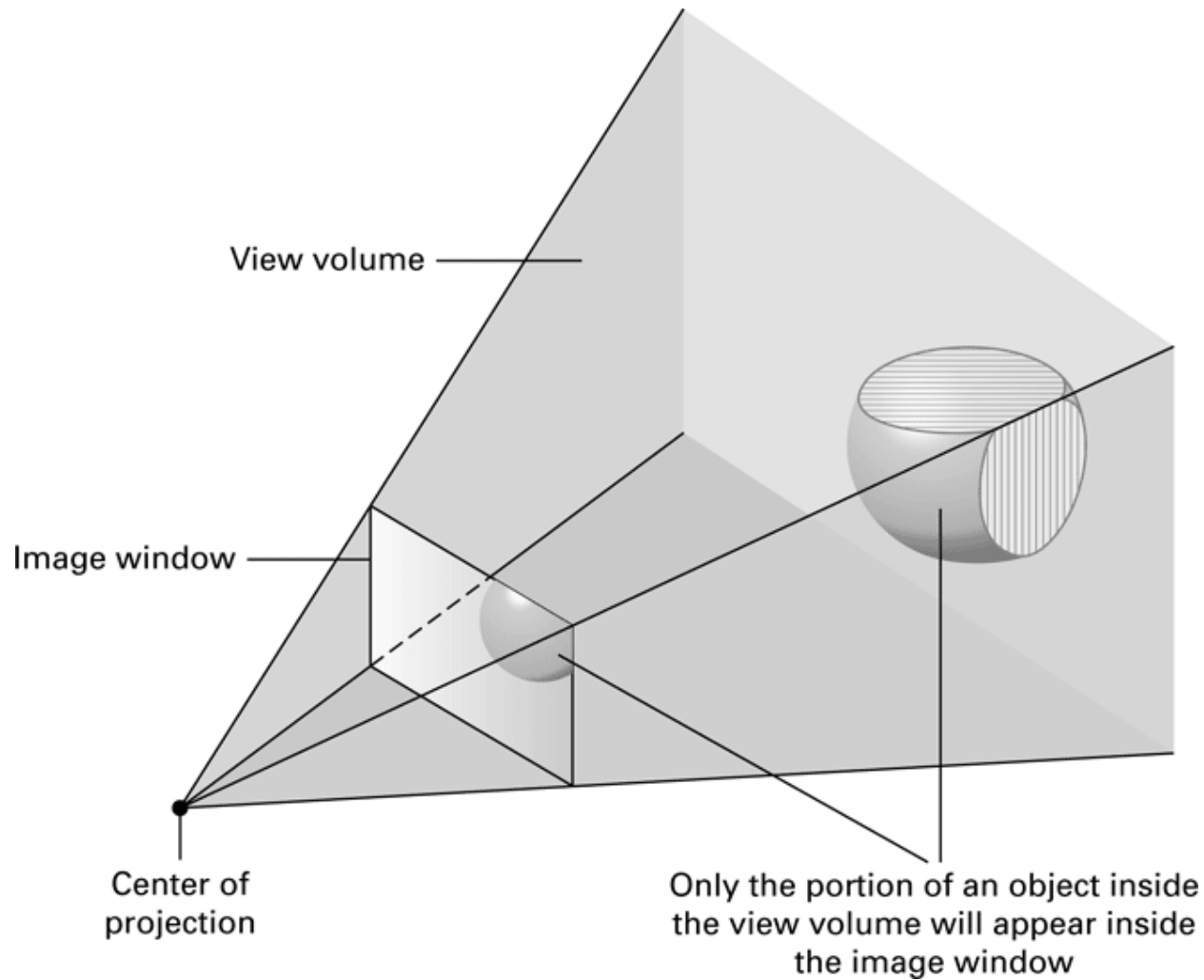
Specular light

Diffuse light

Figure 10.9 Refracted light

Rendering

- **Clipping:** Restricts attention to objects within view volume
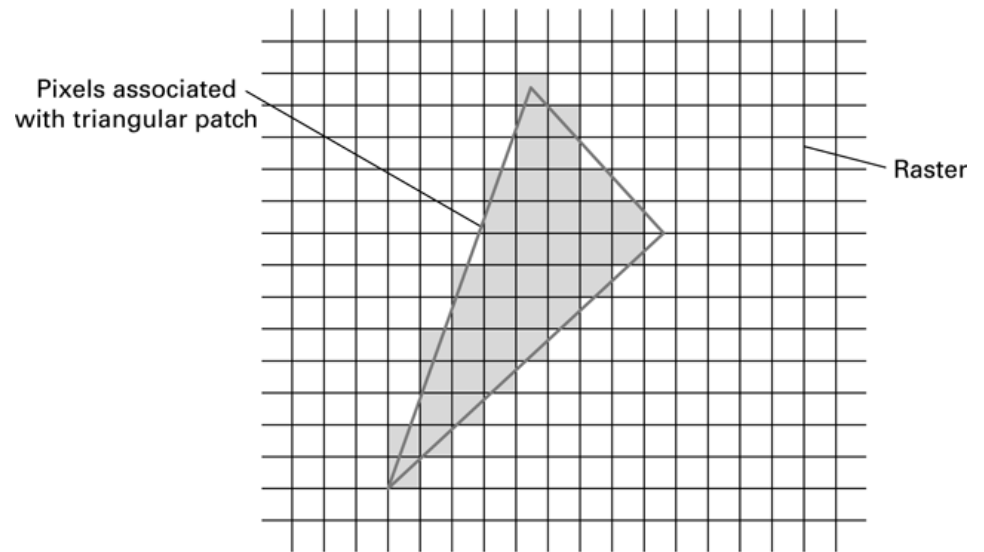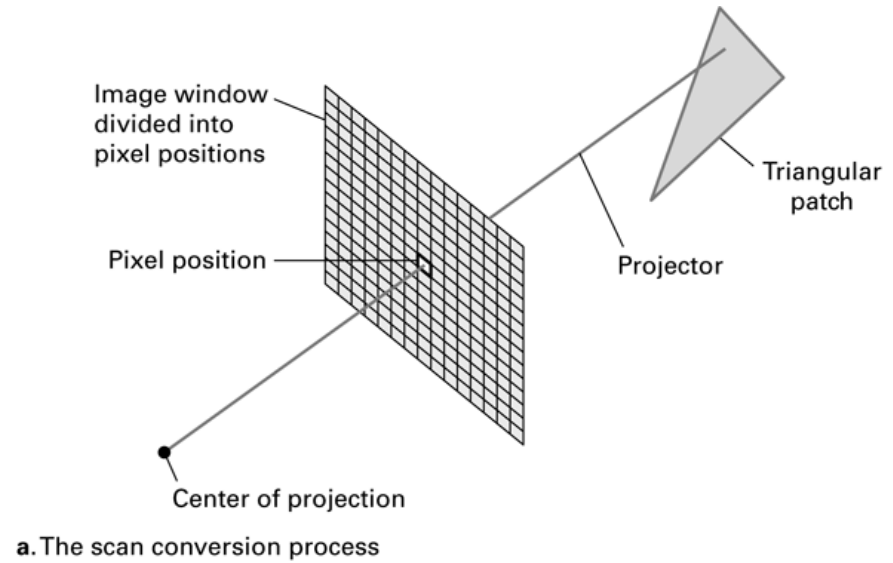
- **Scan Conversion:** Associates pixel positions with points in scene

- **Shading:** Determines appearance of points associated with pixels

Figure 10.10 Identifying the region of the scene that lies inside the view volume

View volume

Image window

Center of projection

Only the portion of an object inside the view volume will appear inside the image window

Figure 10.11 The scan conversion of a triangular patch

Image window divided into pixel positions

Pixel position

Triangular patch

Projector

Center of projection

a. The scan conversion process

Pixels associated with triangular patch

Raster

b. Raster showing the "projected shape" of the triangular patch
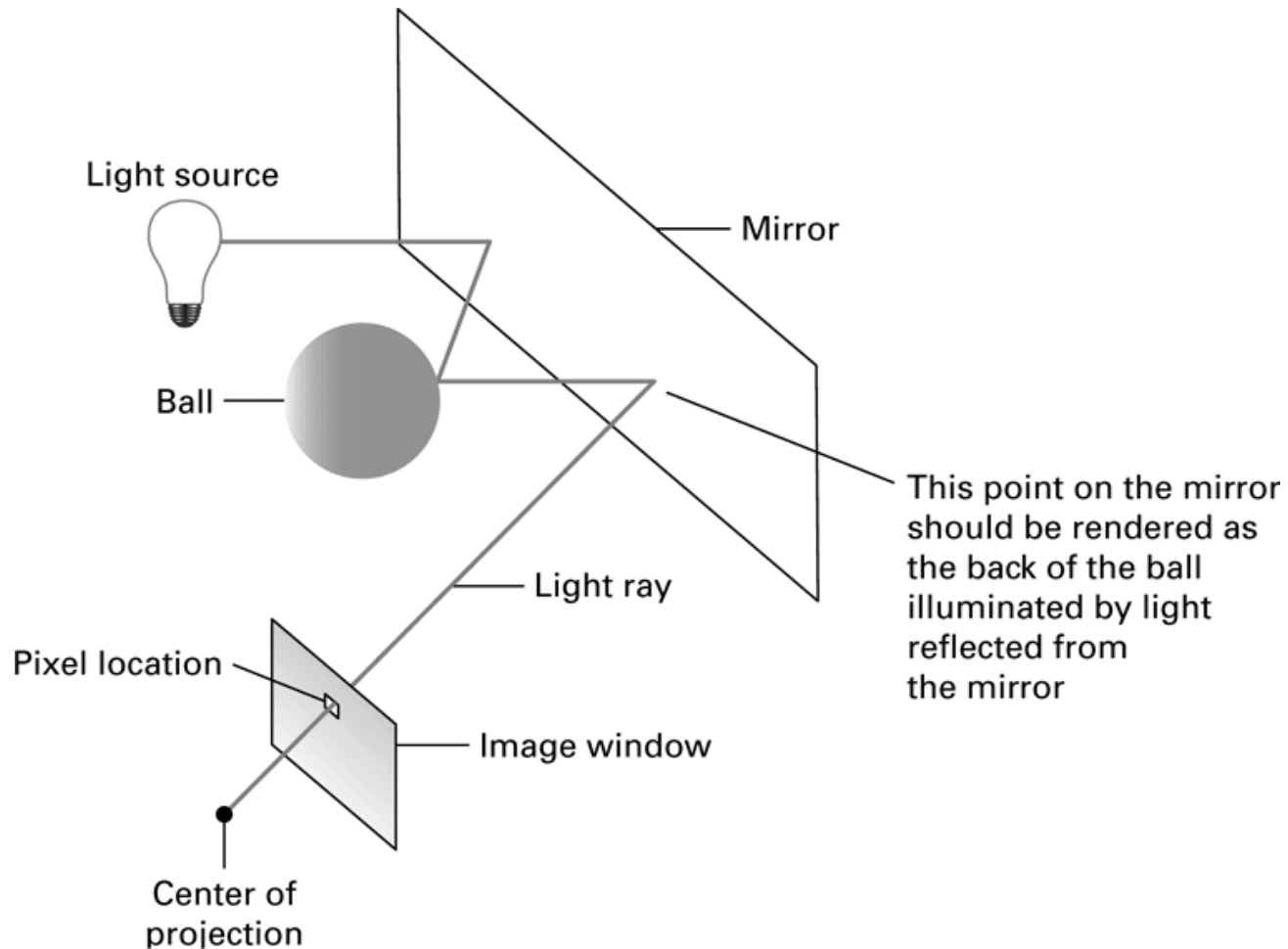
Rendering Pipeline

- Consists of traditional algorithms for clipping, scan conversion, and shading

- Often implemented in firmware

- Used as an abstract tool in graphics applications

Local Versus Global Lighting

- Local Lighting Model: Does not account for light interactions among objects

- Global Lighting Model: Accounts for light interactions among objects
  - Ray Tracing
  - Radiosity

Figure 10.15 Ray tracing

Light source

Mirror

Ball

This point on the mirror
should be rendered as
the back of the ball
illuminated by light
reflected from
the mirror

Light ray

Pixel location

Image window

Center of
projection

Animation

- **Storyboard:** A sequence of sketches summarizing the entire animation
- **Frame:** One of many images used to create animation
- **Key Frames:** Frames capturing the scene at specified points in time
- **In-betweening:** Producing frames to fill the gaps between key frames

Simulating Motion

- **Dynamics:** Applies laws of physics to determine position of objects

- **Kinematics:** Applies characteristics of joints and appendages to determine position of objects
  - Avars
  - Motion Capture