

# Regional Haze Background and History

UDEQ Regional Haze Stakeholder Meeting

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Presented by:

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**The Kendall Group** Inc

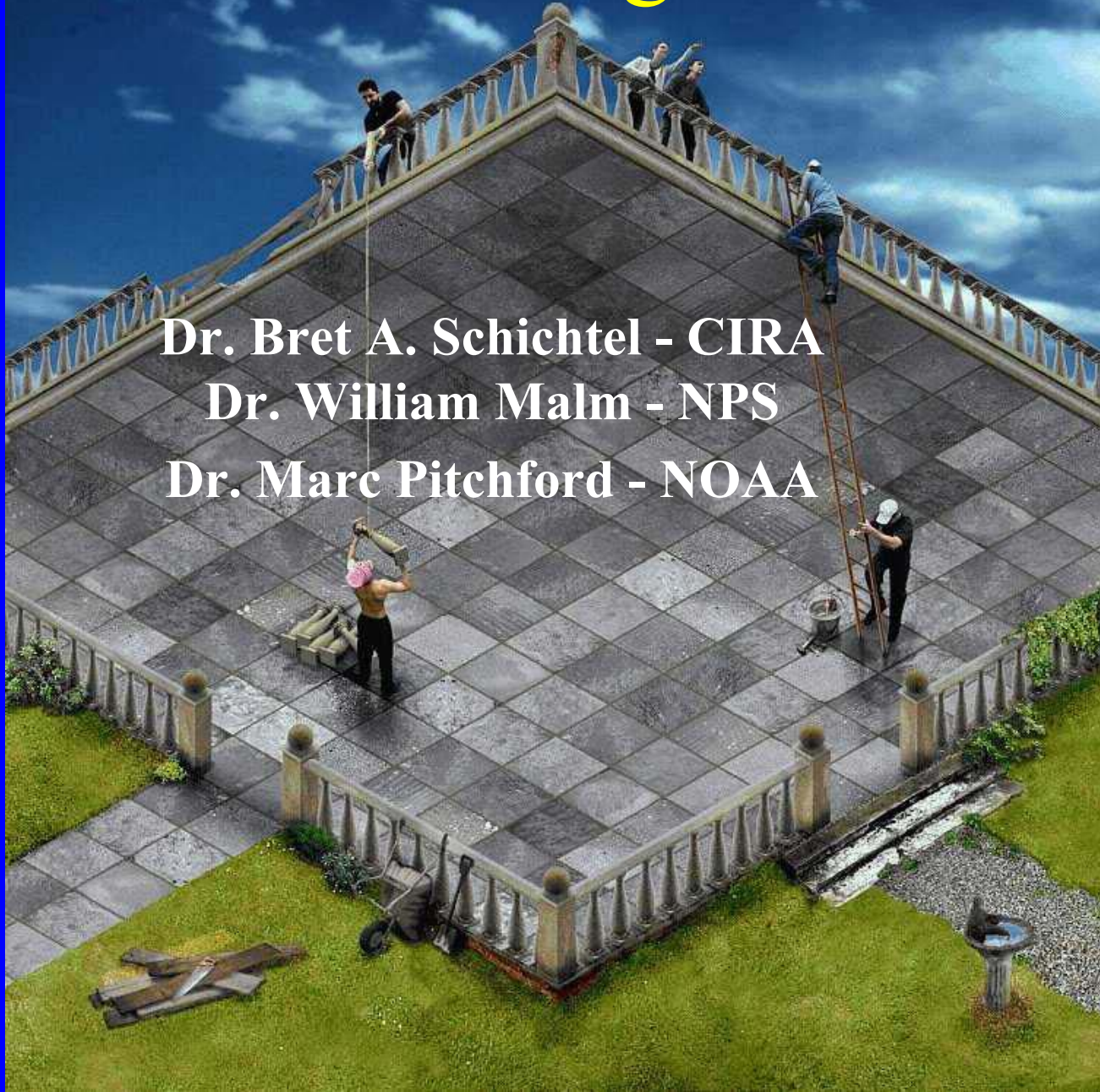
# Presentations

- The Science of Visibility
- Clean Air Act Background
- Grand Canyon Visibility Transport Commission (GCVTC)
- Regional Haze Rule Requirements
- Western Regional Air Partnership
- Utah SIP Development Plan

# **Science of Visibility**

# Acknowledgements

**Dr. Bret A. Schichtel - CIRA**  
**Dr. William Malm - NPS**  
**Dr. Marc Pitchford - NOAA**



# Science Issues

- **What is visibility**
- **How is it impaired**
- **Aerosols and their formation**
- **Visibility and light extinction**
- **Measuring Particulates**

# What is Visibility?

- Historically visibility has been reported in terms of the furthest distance one could see a large black object.
- From a scenic vista perspective, there's more interest in color, contrast, line, texture and form of a scenic landscape feature.

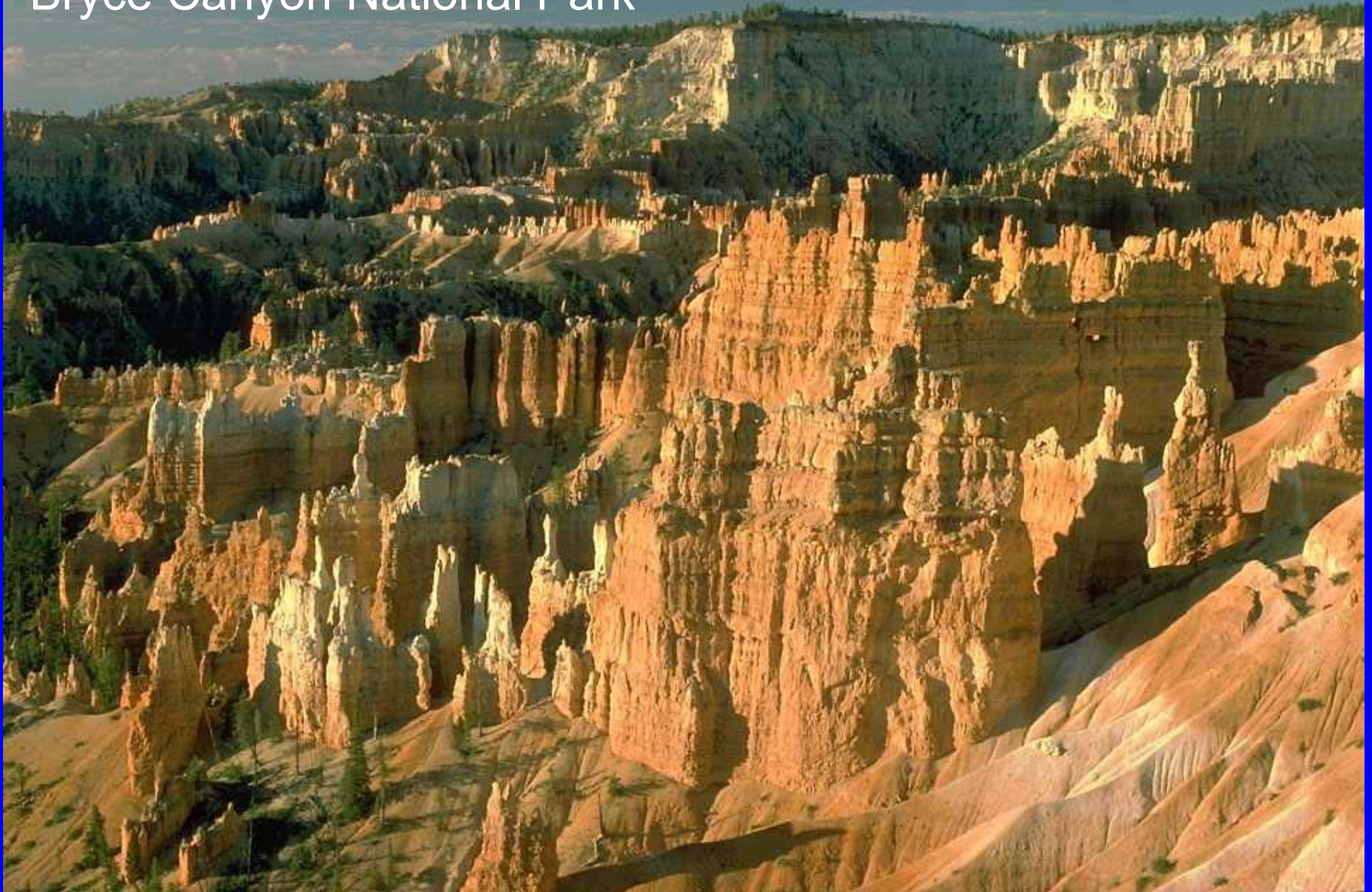
# Manti la Sal near Arches



# Delicate Arch, Arches National Park



# Bryce Canyon National Park



# Canyonlands National Park



# Types of Impairment

## Types of Visibility Impairment



**Layered Haze**



**Plume**



**Uniform Haze**

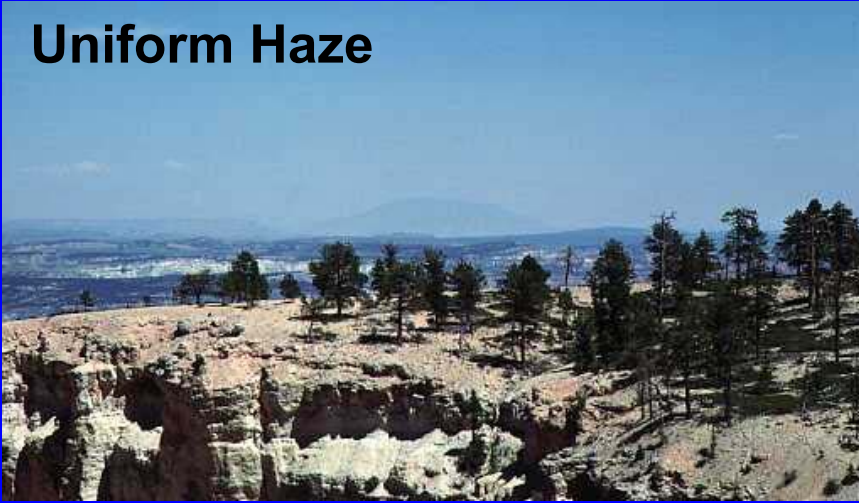
# Bryce Canyon Good/Bad Visibility



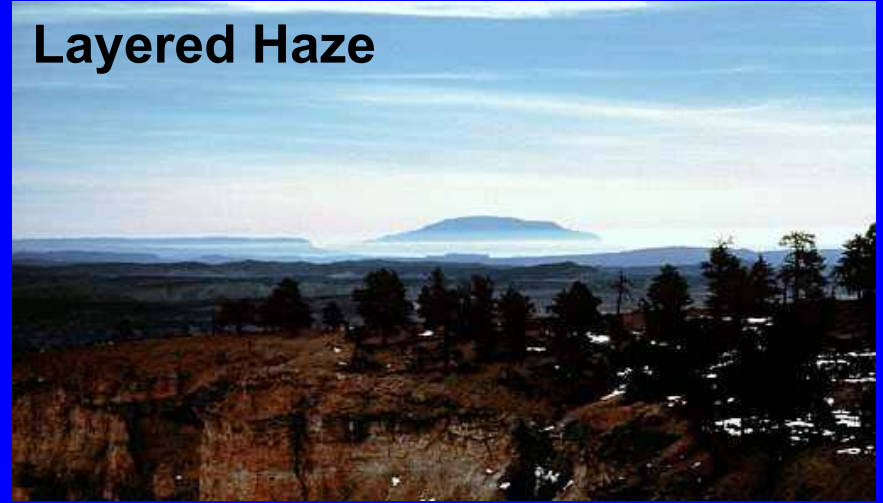
# Examples of Impairment

Navajo Mountain from Bryce Canyon (130 km away)

**Uniform Haze**



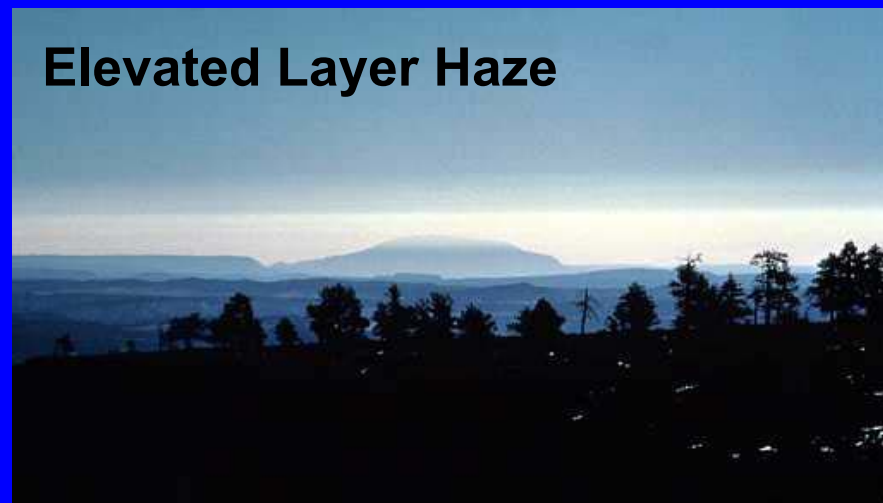
**Layered Haze**



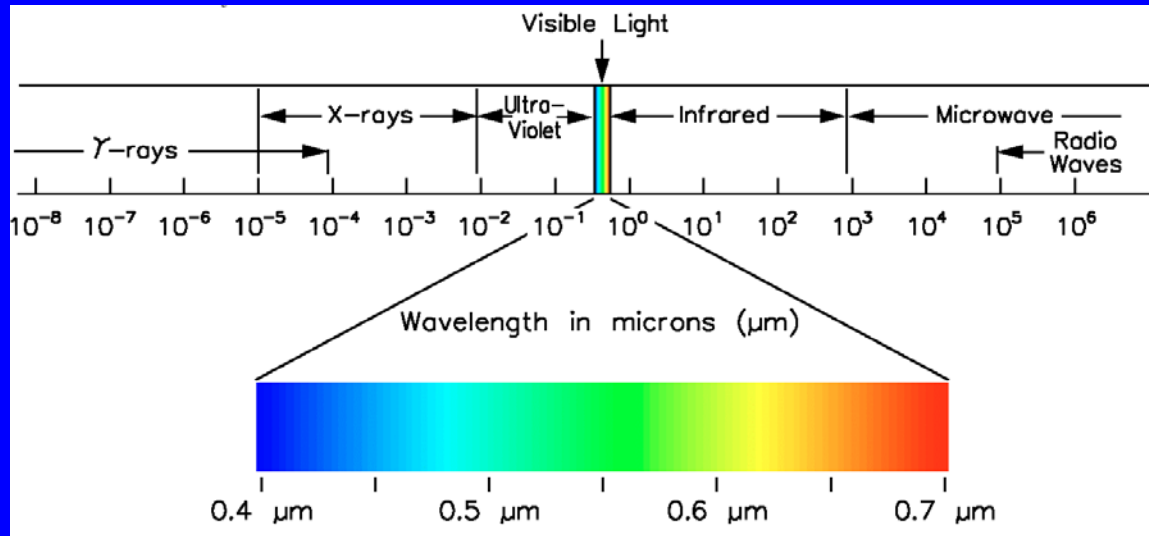
**Plume Blight**



**Elevated Layer Haze**

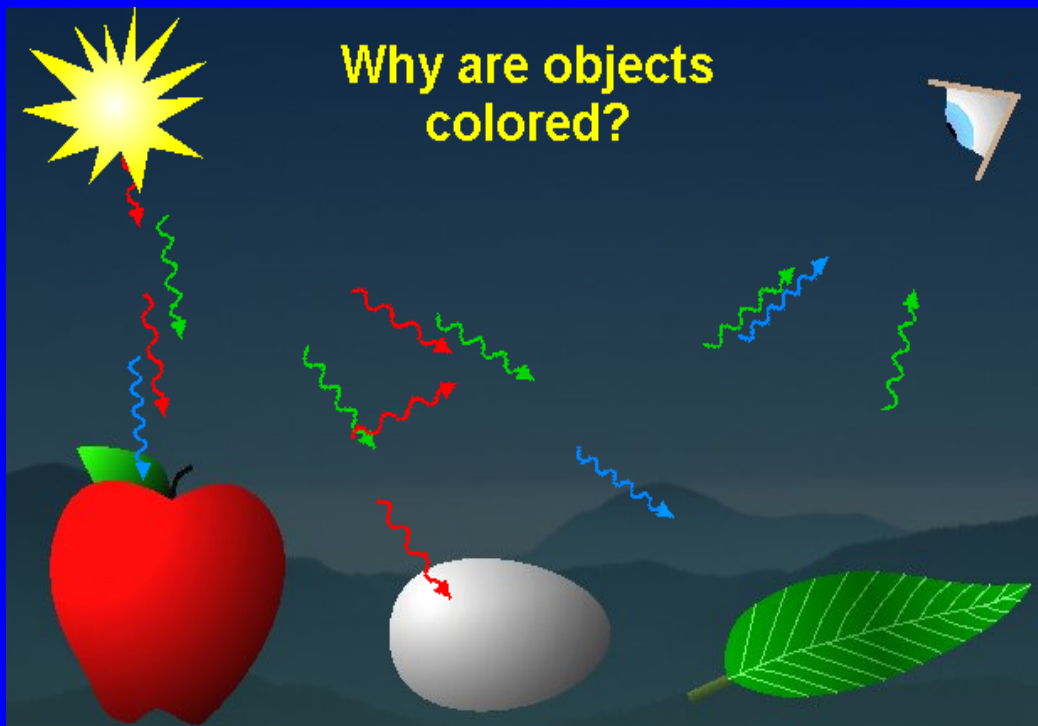


# The Nature of Light

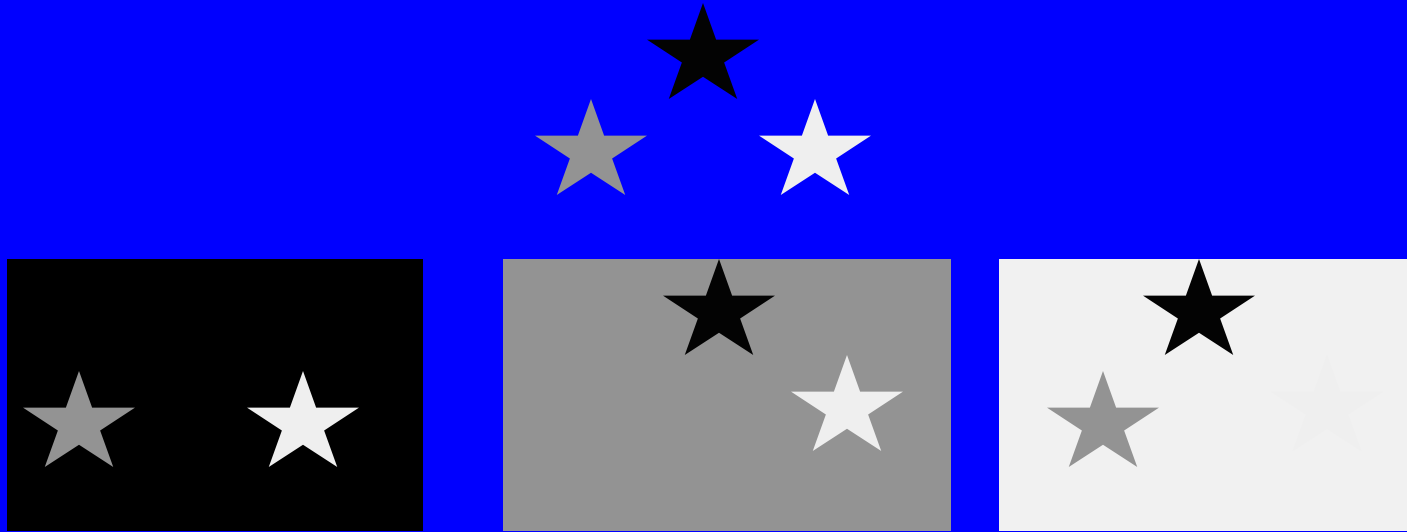


Light - Electromagnetic radiation

- Wave like properties: wave length, frequency and speed
- Photon – discrete entity, i.e. a particle



# How Do We See Objects?



**Each rectangle contains the same three stars as shown above.**

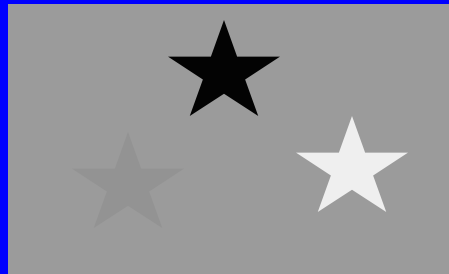
**Objects must have sufficient contrast with their backgrounds to be seen.**

# How Do We See Objects?

- Contrast must be large enough
  - Monochromatic contrast is the difference in brightness and color of an object and its background divided by the brightness of the background
  - $C$  ranges from  $-1$  for a perfectly black object to very large positive numbers for light objects with dark backgrounds

# How Do We See Objects?

- Contrast Threshold,  $C_t$ , is the smallest contrast that can be detected.
  - $C_t$  is about 0.02 or 2%, so to be visible the absolute value of an object's contrast with its background must be at greater than  $\pm 2\%$ .



5% contrast  
between the gray  
star and back  
ground

# How Do We See Objects?

- Contrast is reduced by
  - Reducing image-forming light –  
reduced signal
  - Adding non-image forming light –  
increased noise