



Can a Good Climate Go Bad?

Understanding the Diagnosis

Presented by
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National Center for Atmospheric Research

July 25, 2006

6th Annual Environmental Health Sciences Summer Institute for K-12 Educators
University of Texas, Austin

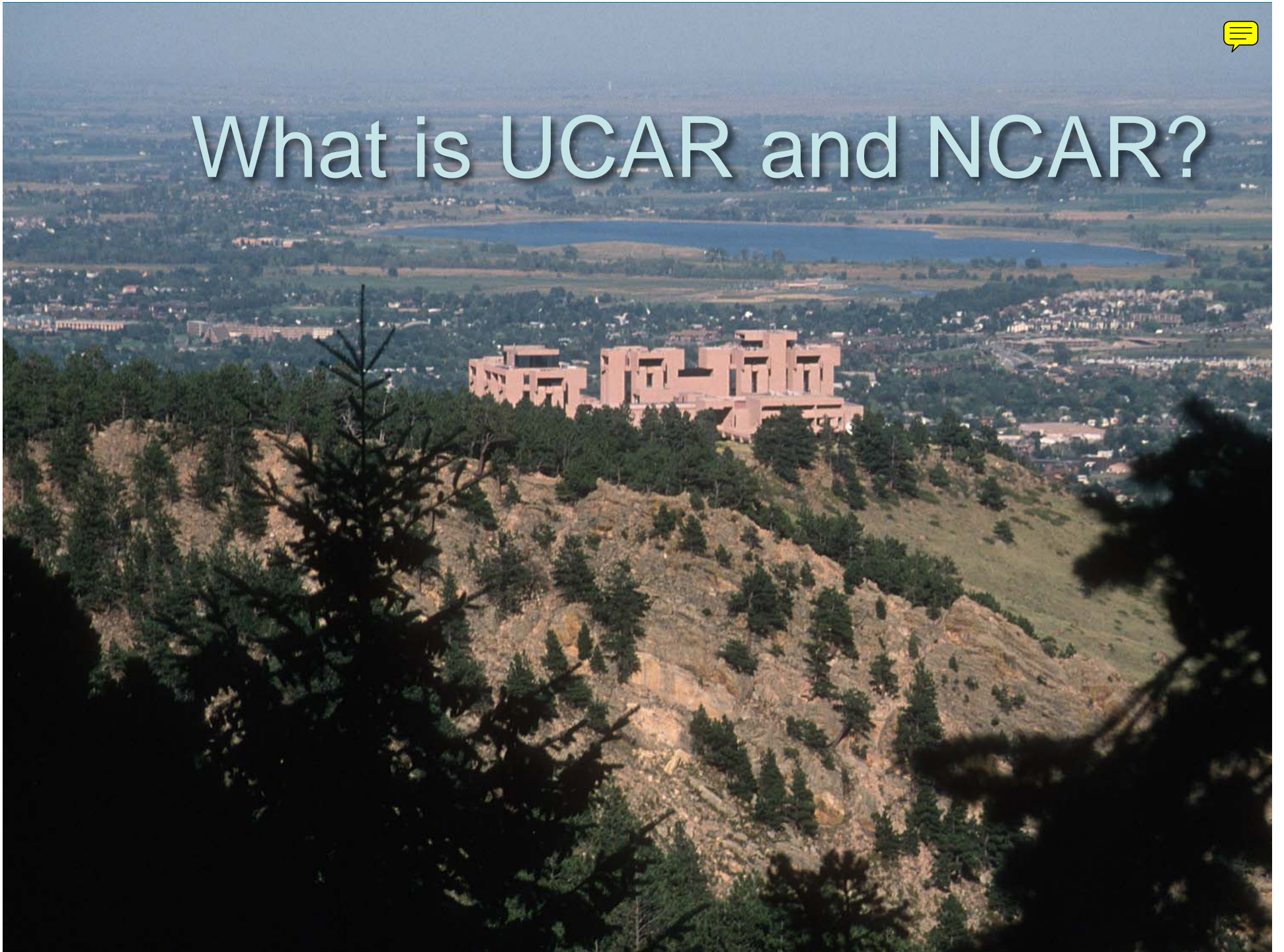
Welcome!

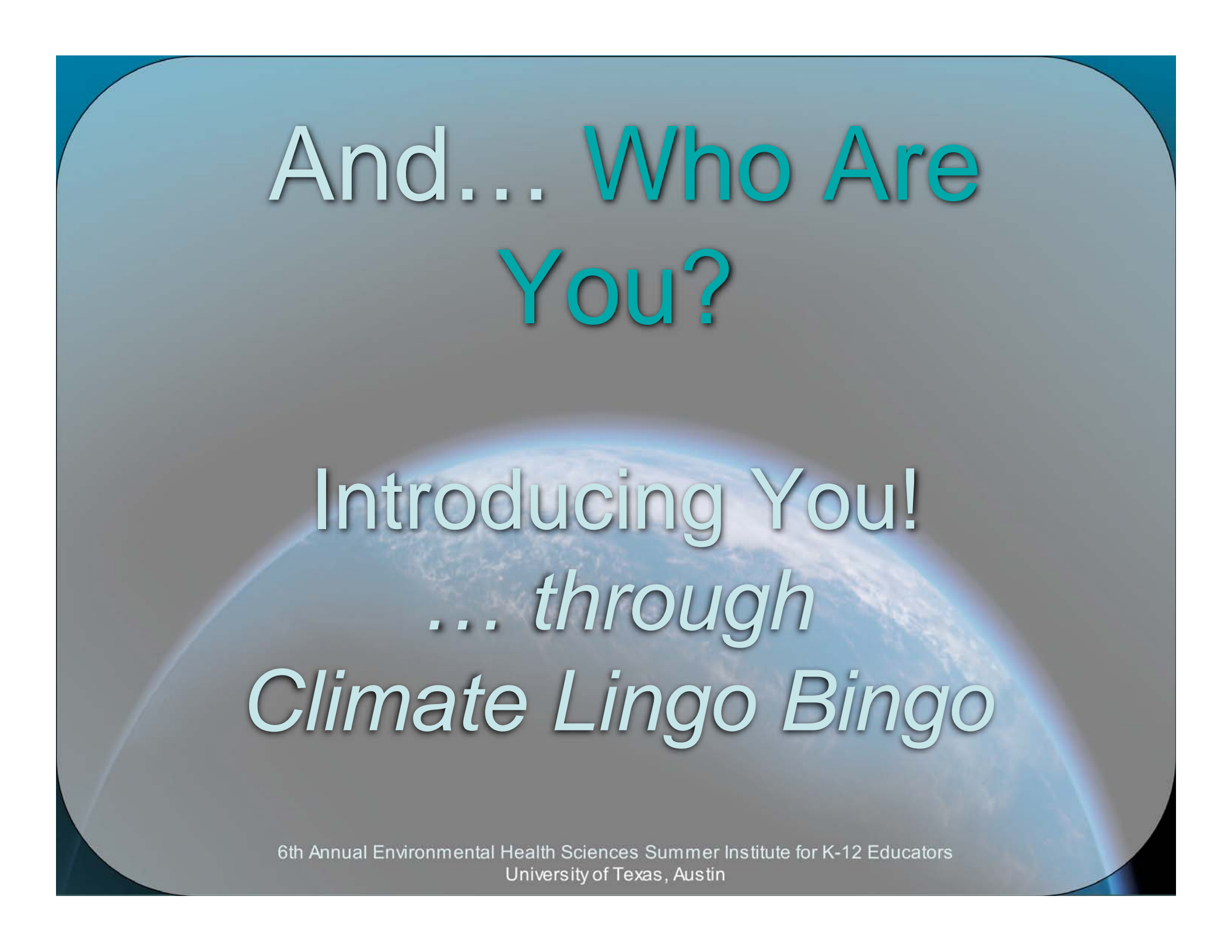
While you are waiting, please
fill out a climate change survey.

Thank you!



What is UCAR and NCAR?





And... Who Are
You?

Introducing You!
... through
Climate Lingo Bingo

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What are our goals
and objectives today?

*You tell us yours and we'll tell you
ours!*

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Our Goals for Today

- To foster confidence in your ability to understand and to teach students about climate change and its relevance in their lives
- To present meaningful activities that will enhance and/or reinforce student understanding
- To foster worthwhile discussions around information and issues presented during the workshop
- To have fun and learn from one another

Outline of Topics for Today

Part 1: Earth as a System

Earth and Energy

Part 2: Earth's Past Climate

Climate Models

Climate & Weather -- the Two Go Together

Part 3: Climate Now

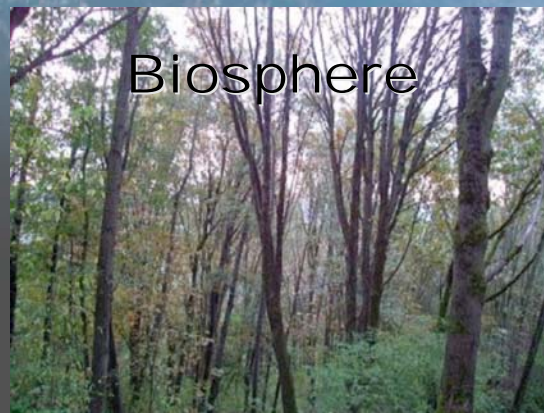
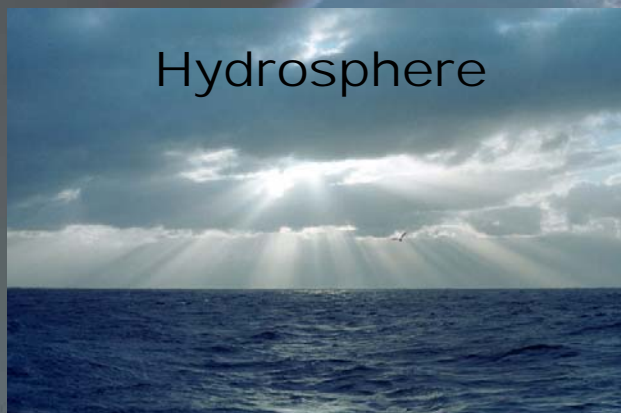
Climate Future

Part 4: Climate Care

Connections

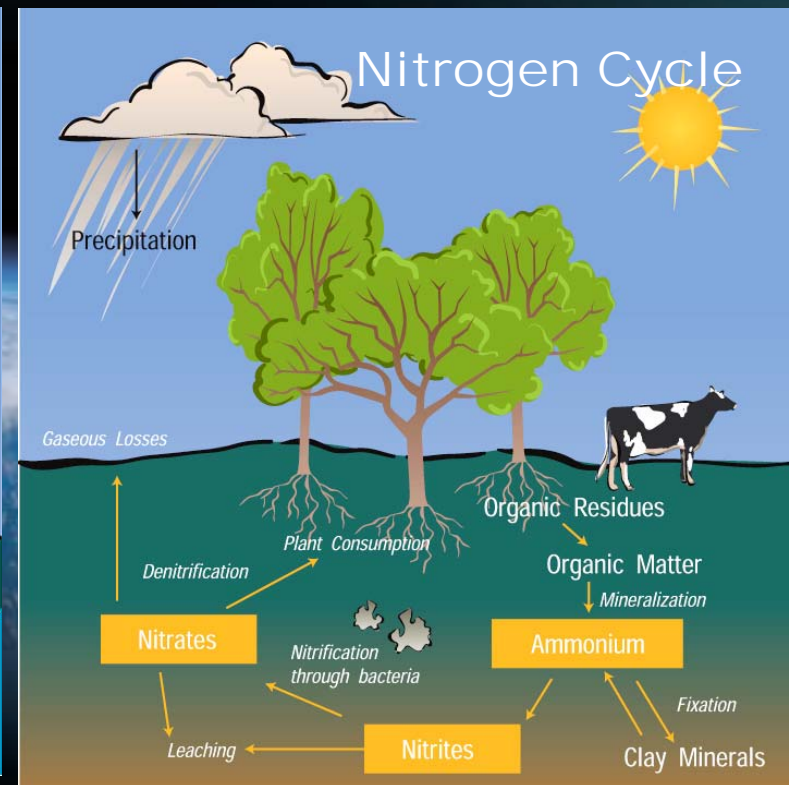
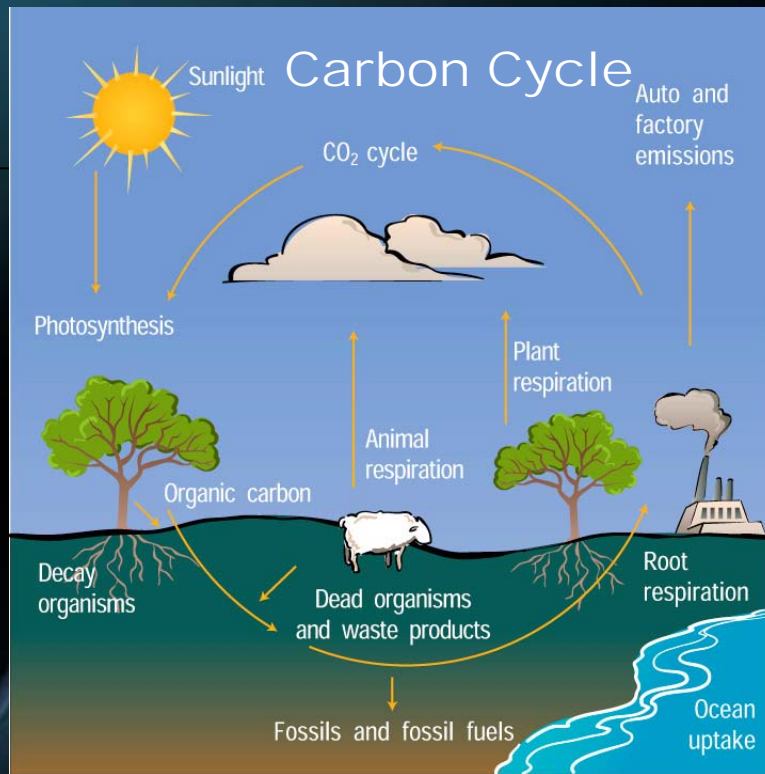


Part 1: The Earth System





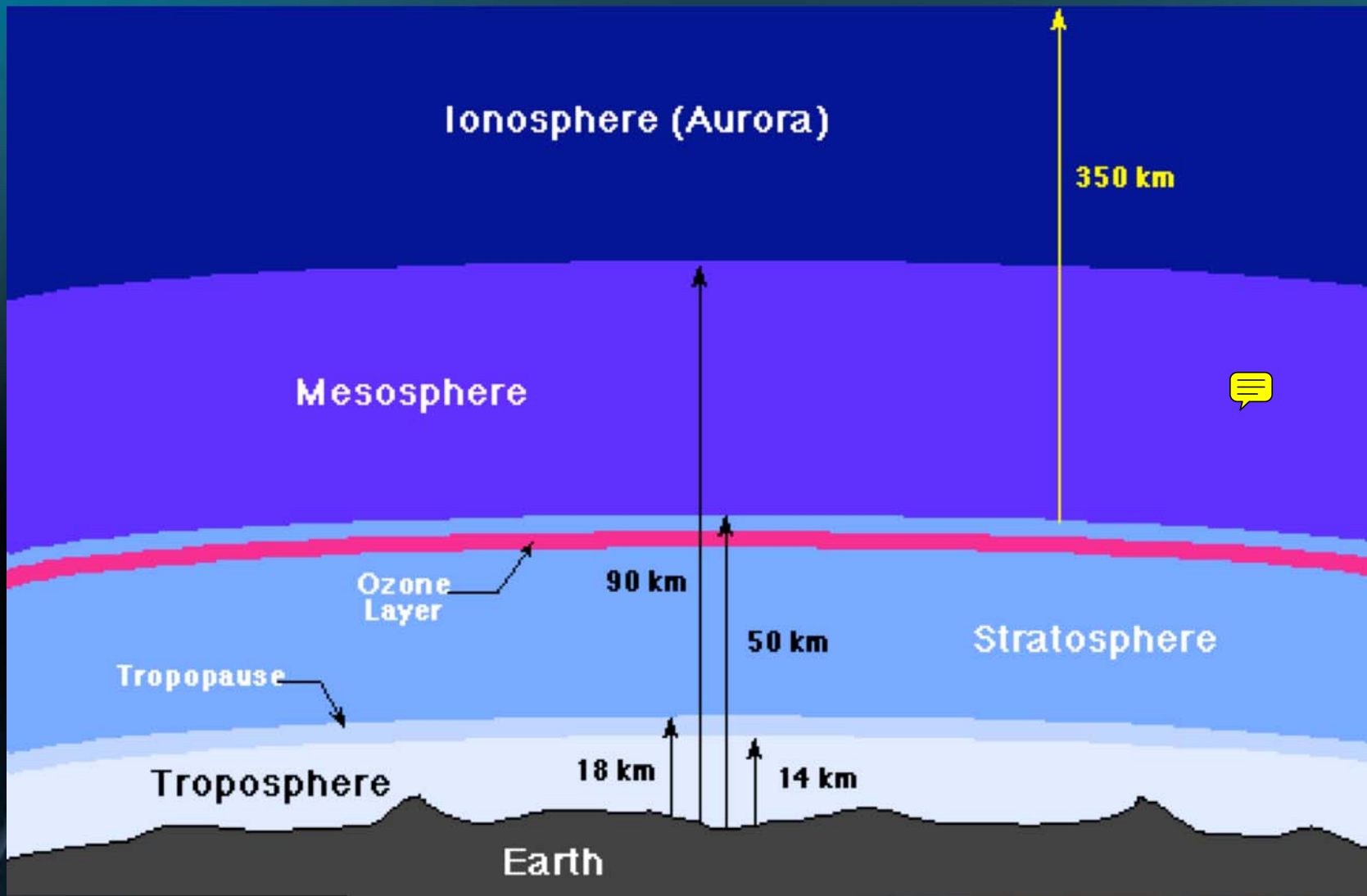
Within Each System There are Subsystems



Source: NCAR, *Climate Discovery*

A photograph of a sky filled with scattered, fluffy clouds. The clouds are illuminated from the side, giving them a golden or yellowish glow, while the sky between them is a deep, clear blue. The overall mood is serene and atmospheric.

An introduction to our
atmosphere!

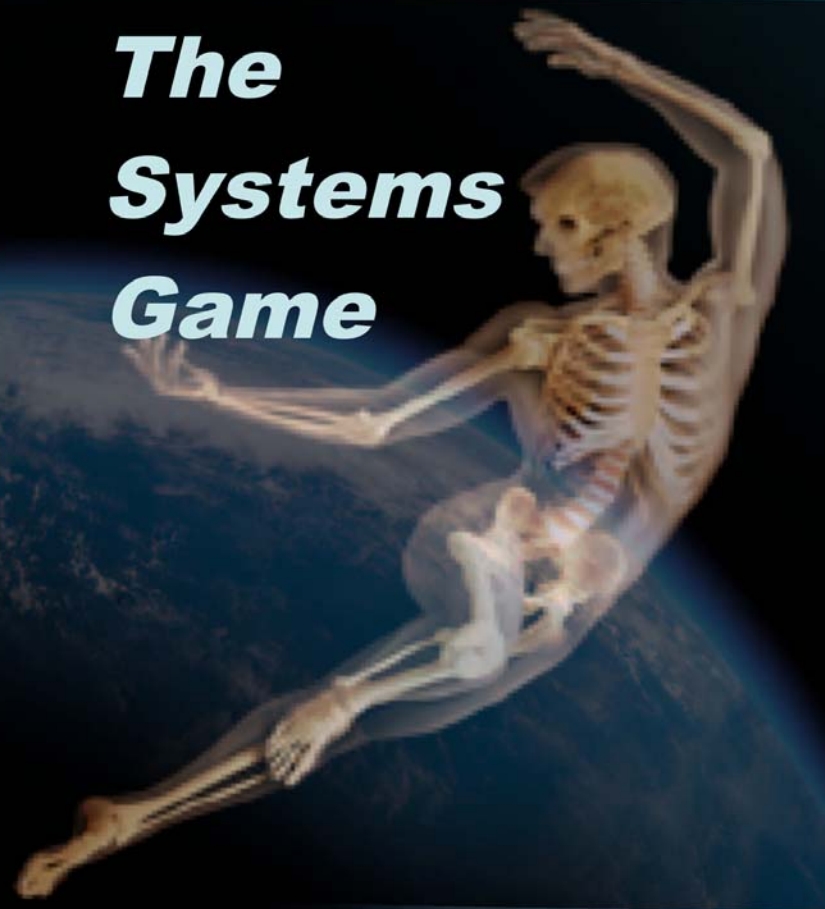




Activities

*Similarities
Between
the Earth
System &
the Human
Body
System*

**The
Systems
Game**



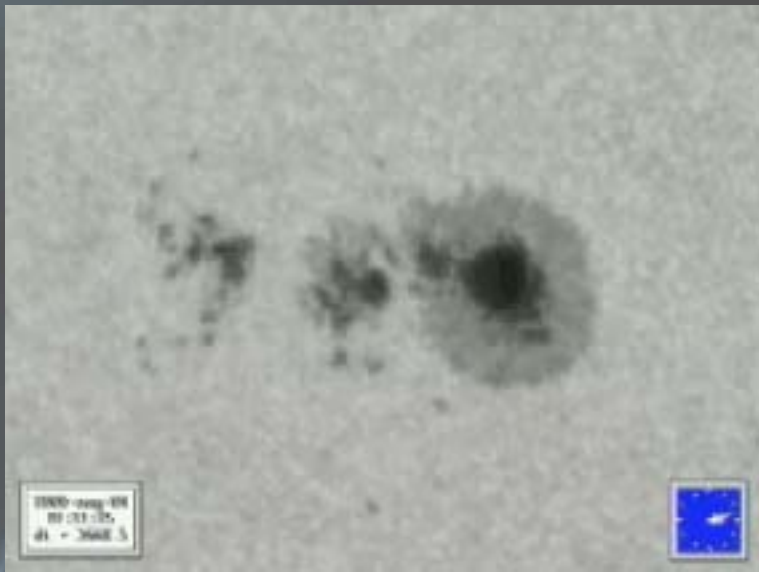
EARTH & ENERGY

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Sunspots

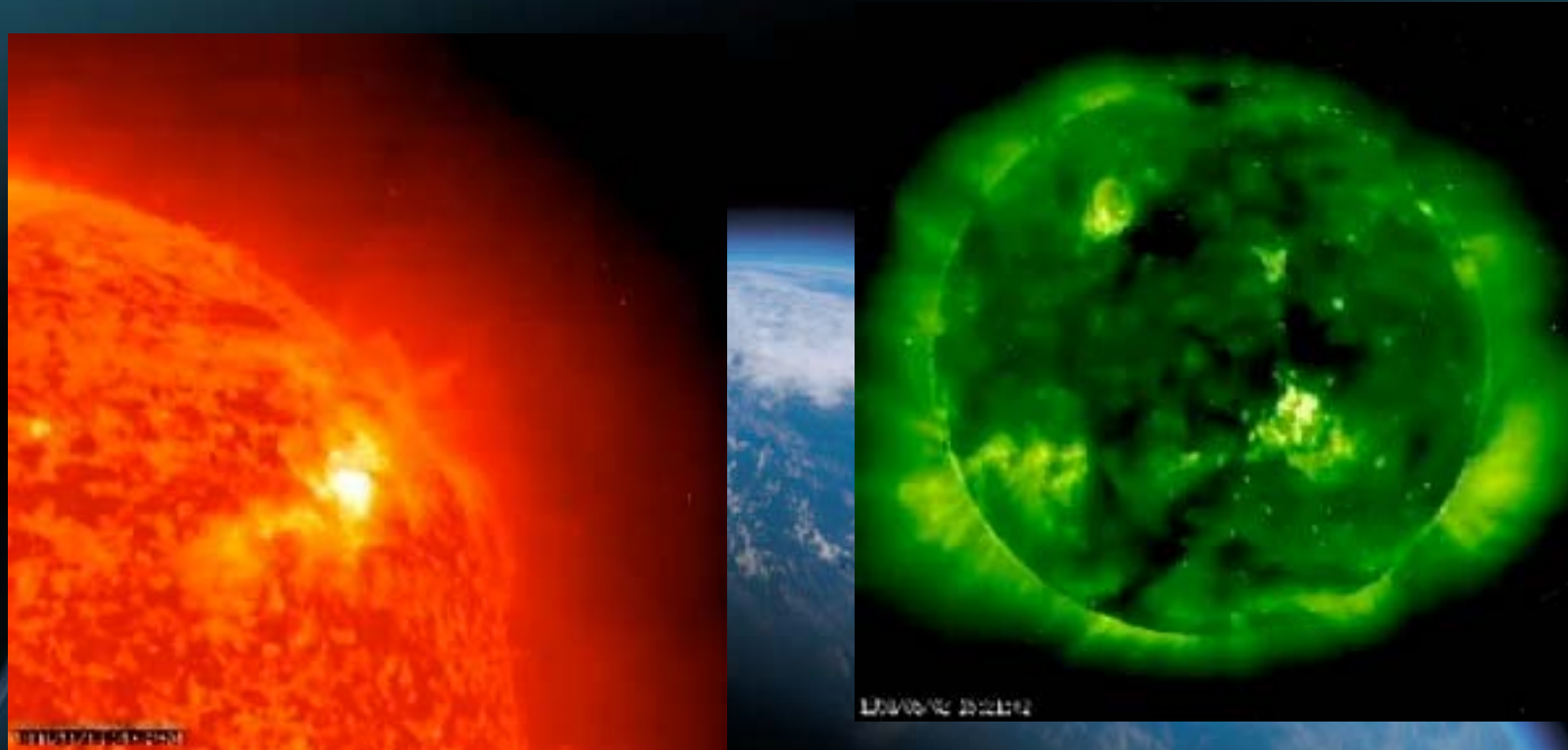
Magnetic “loops” near sunspot area



Source NASA TRACE Spacecraft



Solar Flares



Source: NASA

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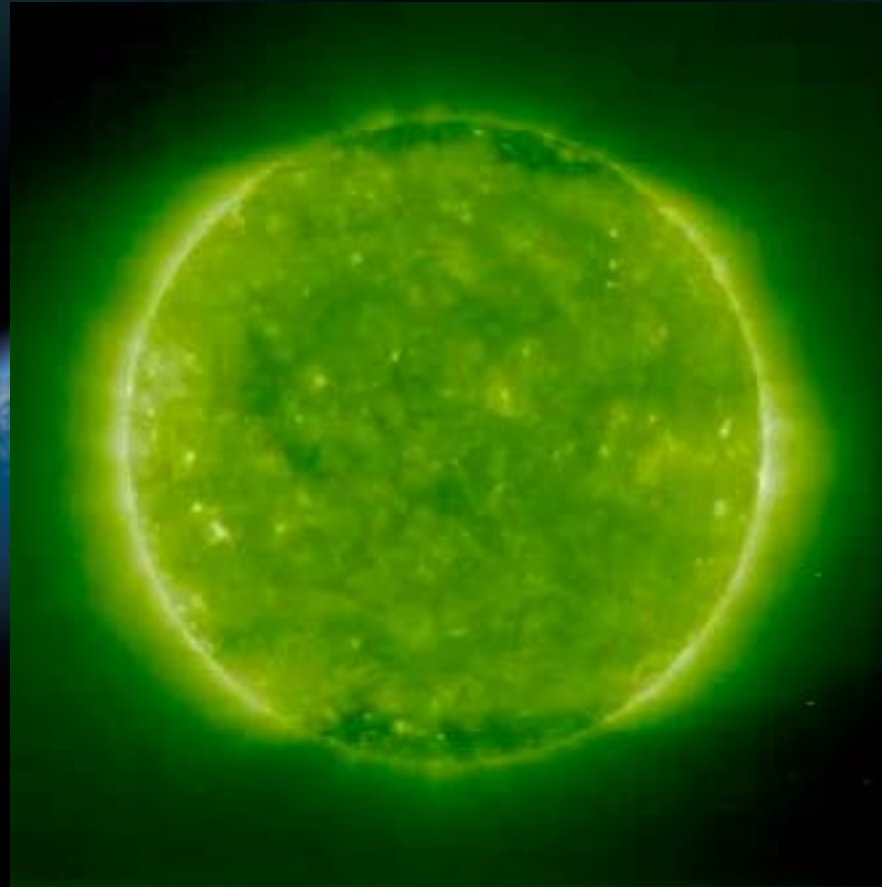
Coronal Mass Ejection



Source: NASA



Solar Cycle



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Earth's Magnetosphere



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Activity on The Nature of Light -

Absorption, Reflection (Scattering), Transmission,
Combination of These



Meet the Photon Folks

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ALBEDO ACTIVITY

Albedo – the amount of light energy reflected by the Earth, measured on a scale from 0 to 1 or 0 to 100%

***Earth's average albedo is about 0.31 or 31%.
Snow has a high albedo; the ocean has a low albedo.***



Taking Light Apart; Putting It Back Together

The Sun
in Visible Light --

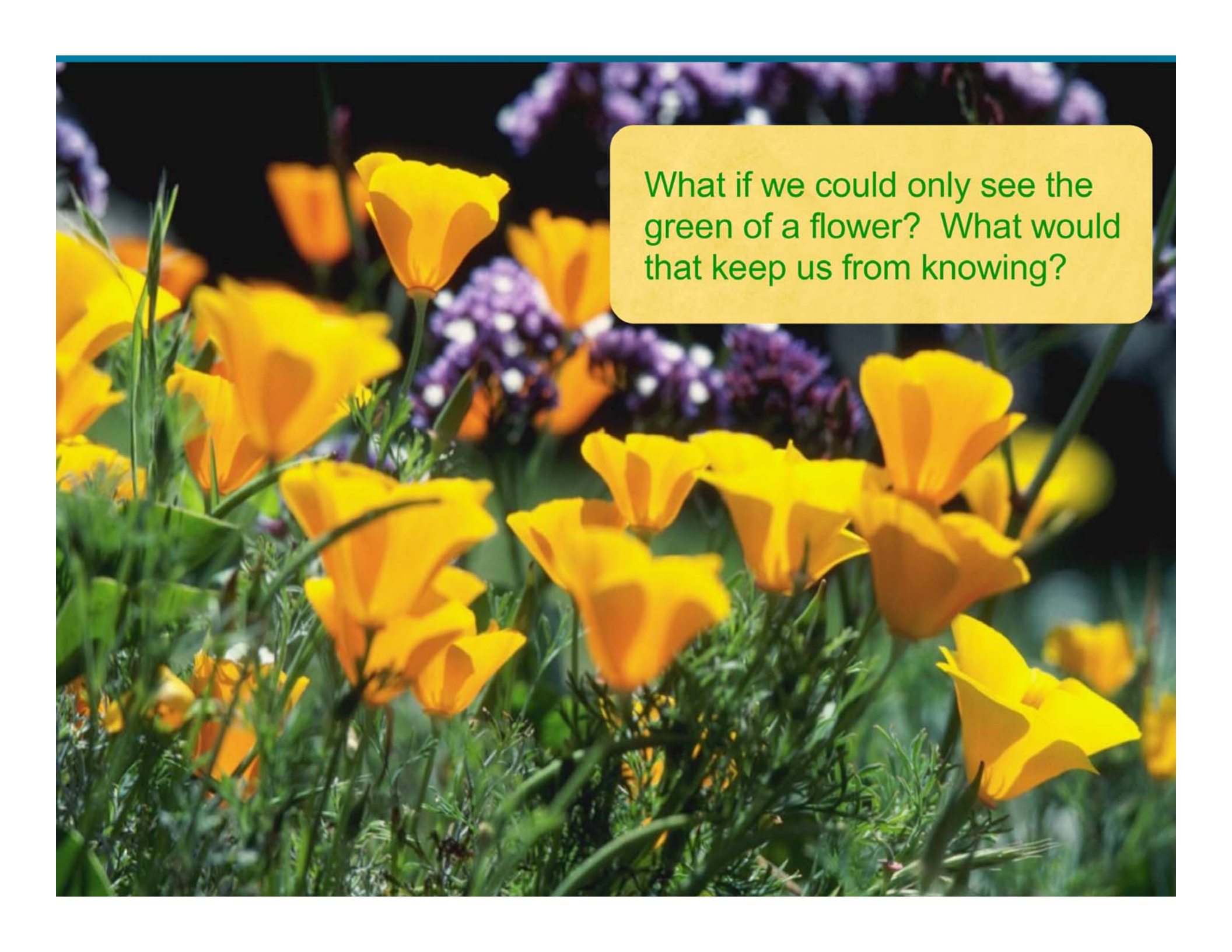
What
color is
this light?

White?
Are you
sure?

Let's find out!



*White-light image of the sun. Taken on
September 13, 2001 by the Big Bear
Observatory*

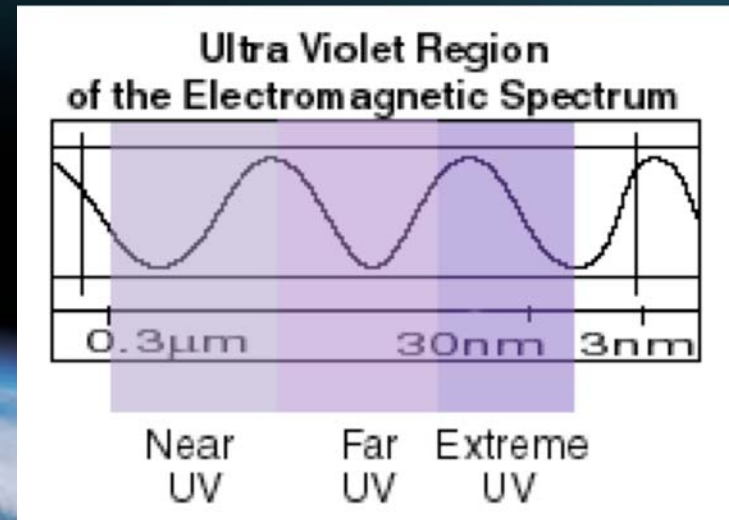
A photograph of a field of flowers. In the foreground, there are several bright yellow, bell-shaped flowers (likely California poppies) in various stages of bloom. Behind them, there are clusters of small purple flowers. The background is a soft-focus green, suggesting more foliage. A yellow rounded rectangle is overlaid on the right side of the image, containing a question in green text.

What if we could only see the green of a flower? What would that keep us from knowing?



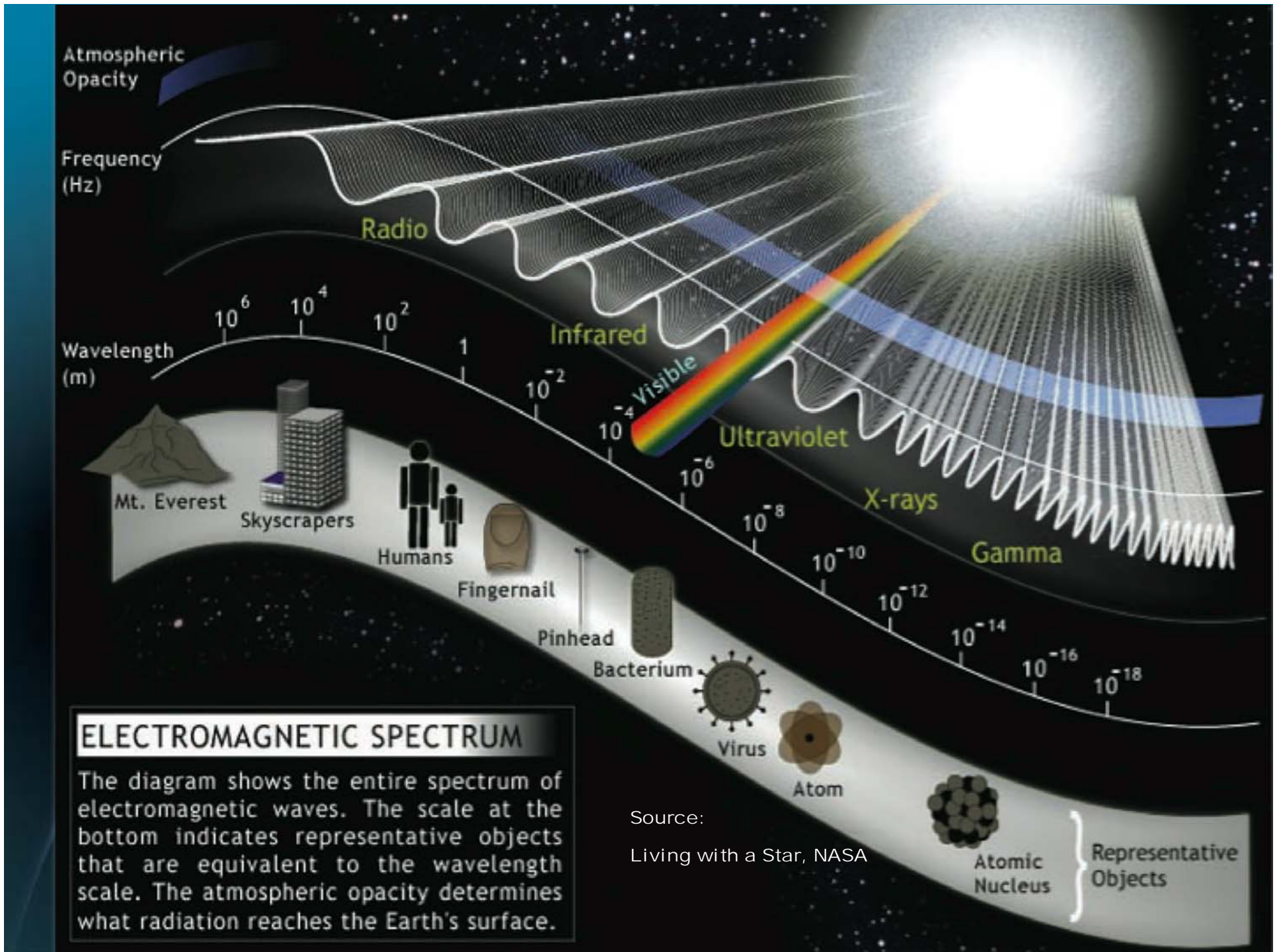
Ultraviolet Light

Infrared Light



Visible Light



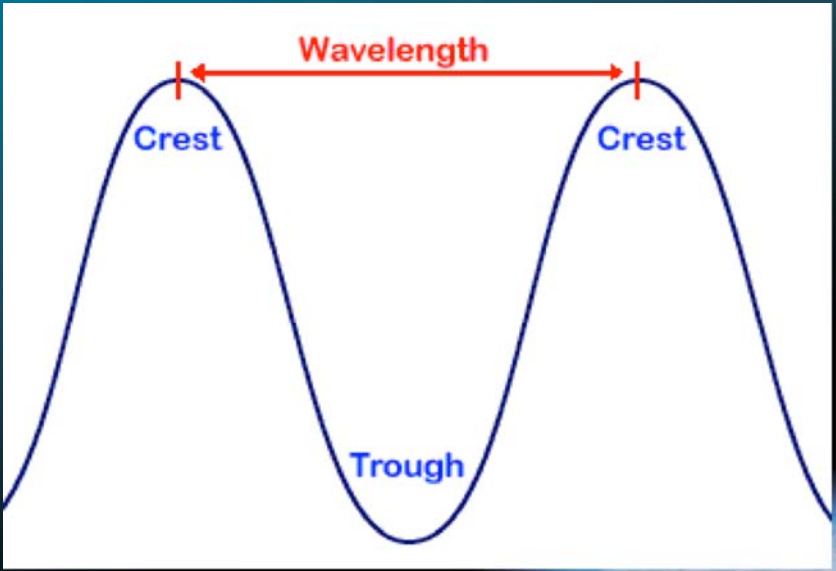


ELECTROMAGNETIC SPECTRUM
 The diagram shows the entire spectrum of electromagnetic waves. The scale at the bottom indicates representative objects that are equivalent to the wavelength scale. The atmospheric opacity determines what radiation reaches the Earth's surface.

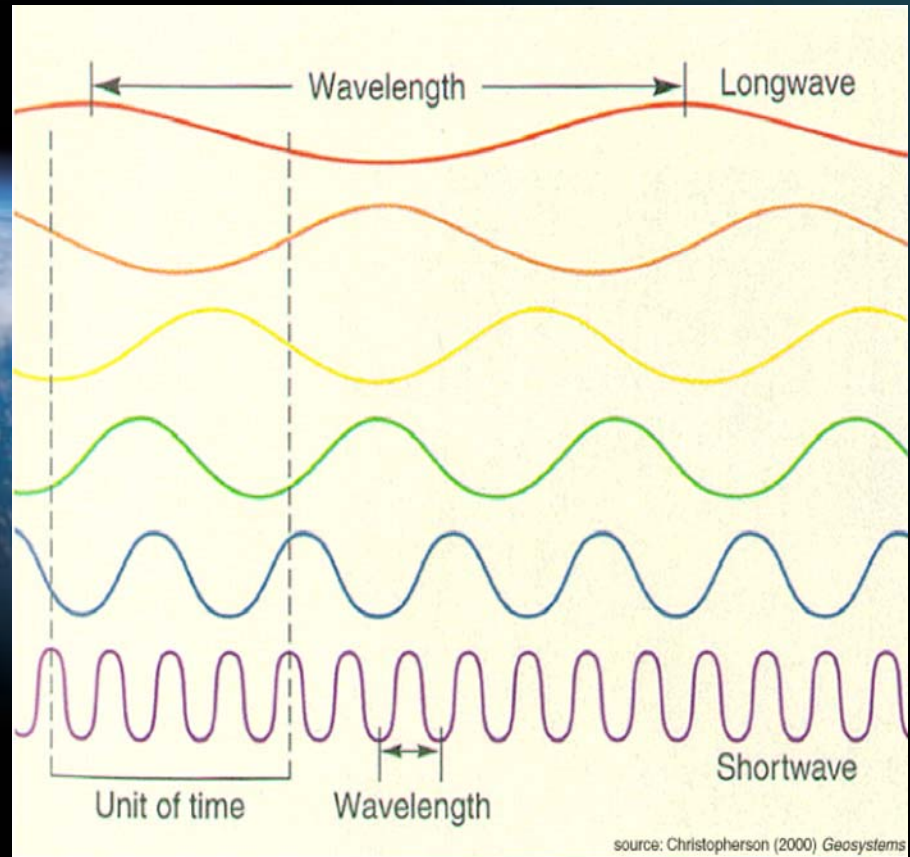
Source:
 Living with a Star, NASA



Frequency is the number of waves in a given unit of time, usually a second. Frequency is measured in **Hertz.**

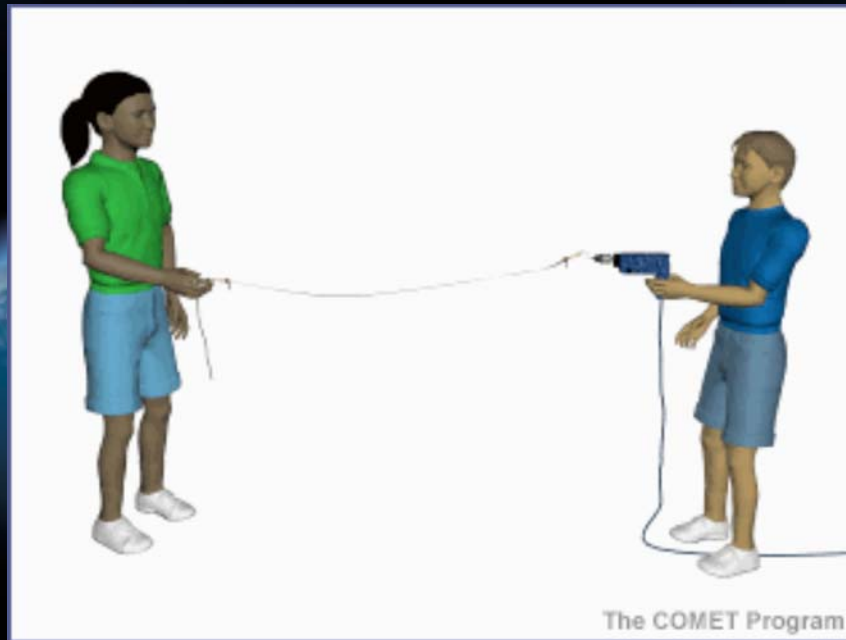


Wavelength is the distance from the crest of one wave to the crest of the next. Wavelength is measured in **meters.**



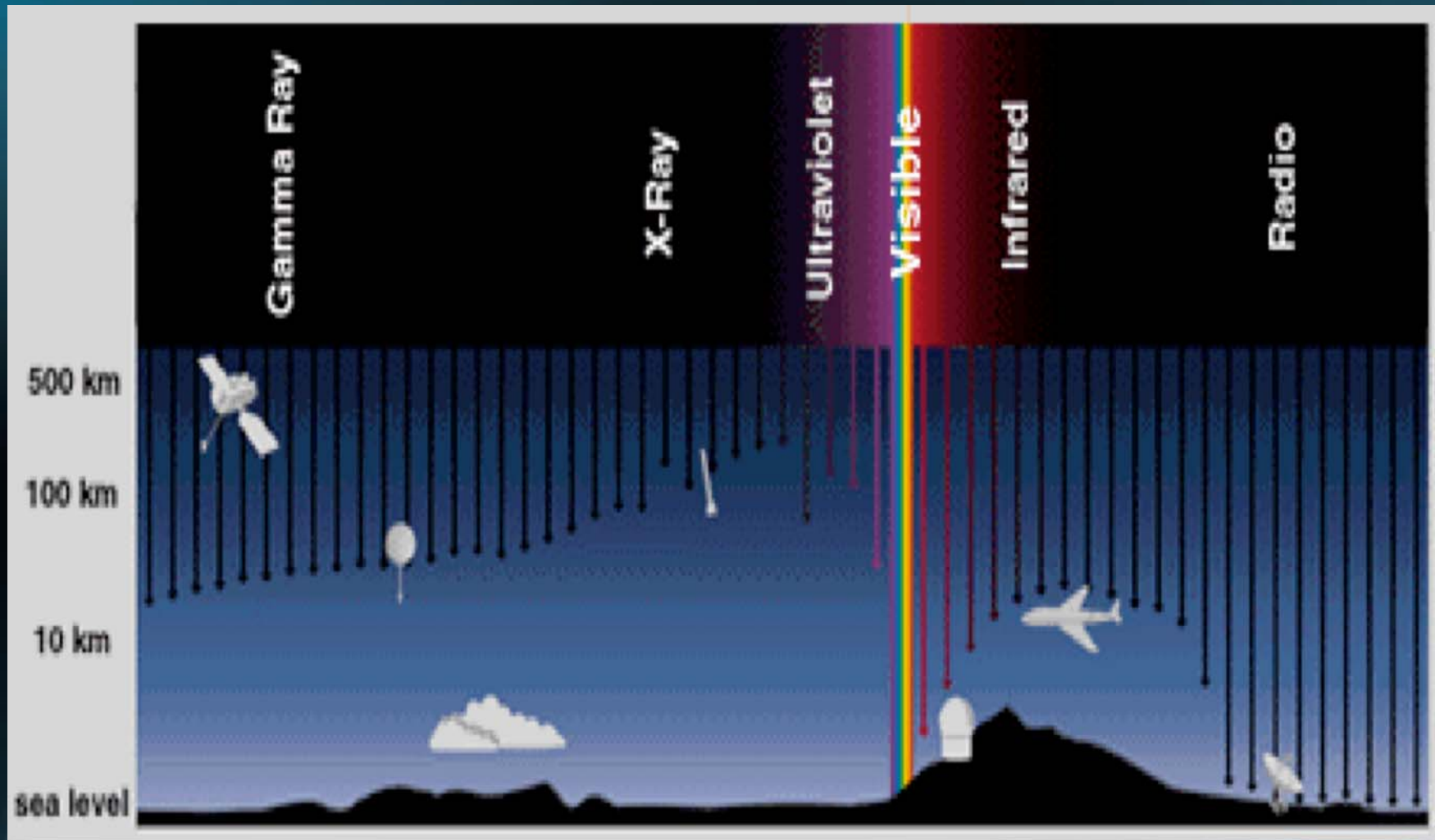
Wave Demo Activity

from NCAR's Project LEARN





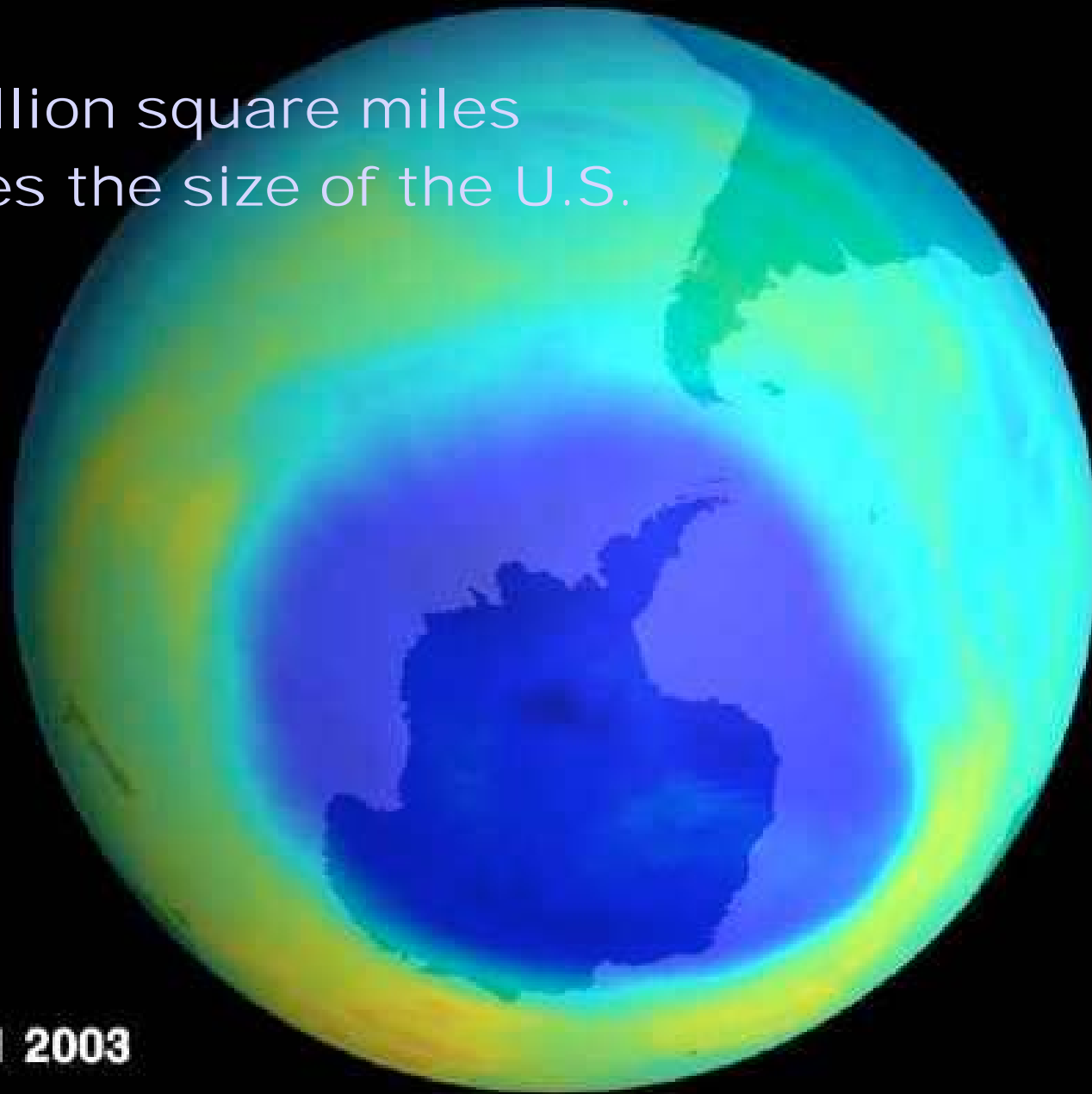
Our Atmospheric Filter



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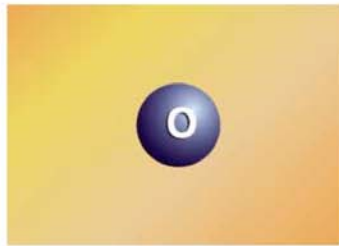
11 million square miles
3 times the size of the U.S.



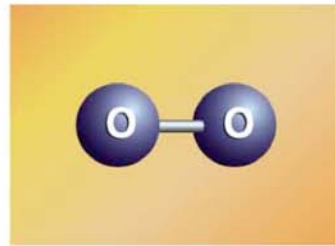
Sep 11 2003

Ozone and Oxygen

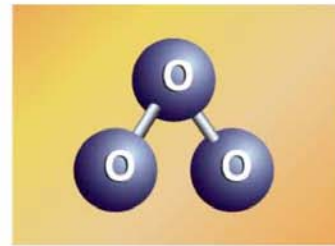
Oxygen
Atom (O)



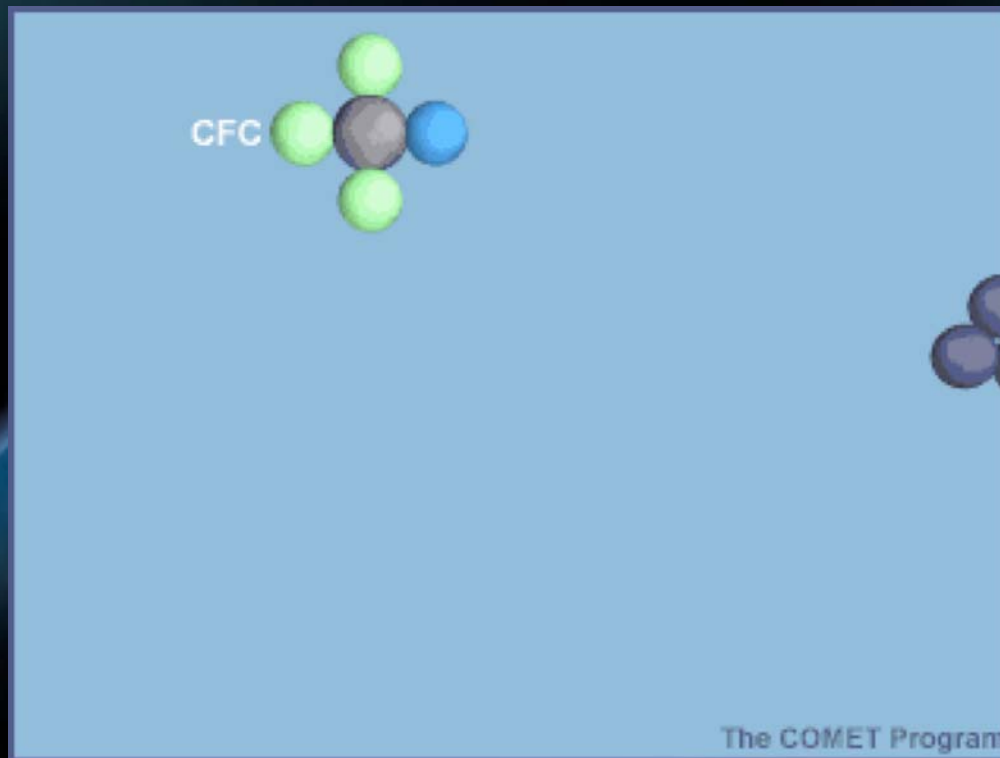
Oxygen
Molecule (O₂)



Ozone
Molecule (O₃)



Ozone Depletion in the Stratosphere by CFCs





Has the Montreal Protocol solved everything?

In a word, no. We're not adding *new* CFCs to the atmosphere, but the ones we released earlier haven't gone away.



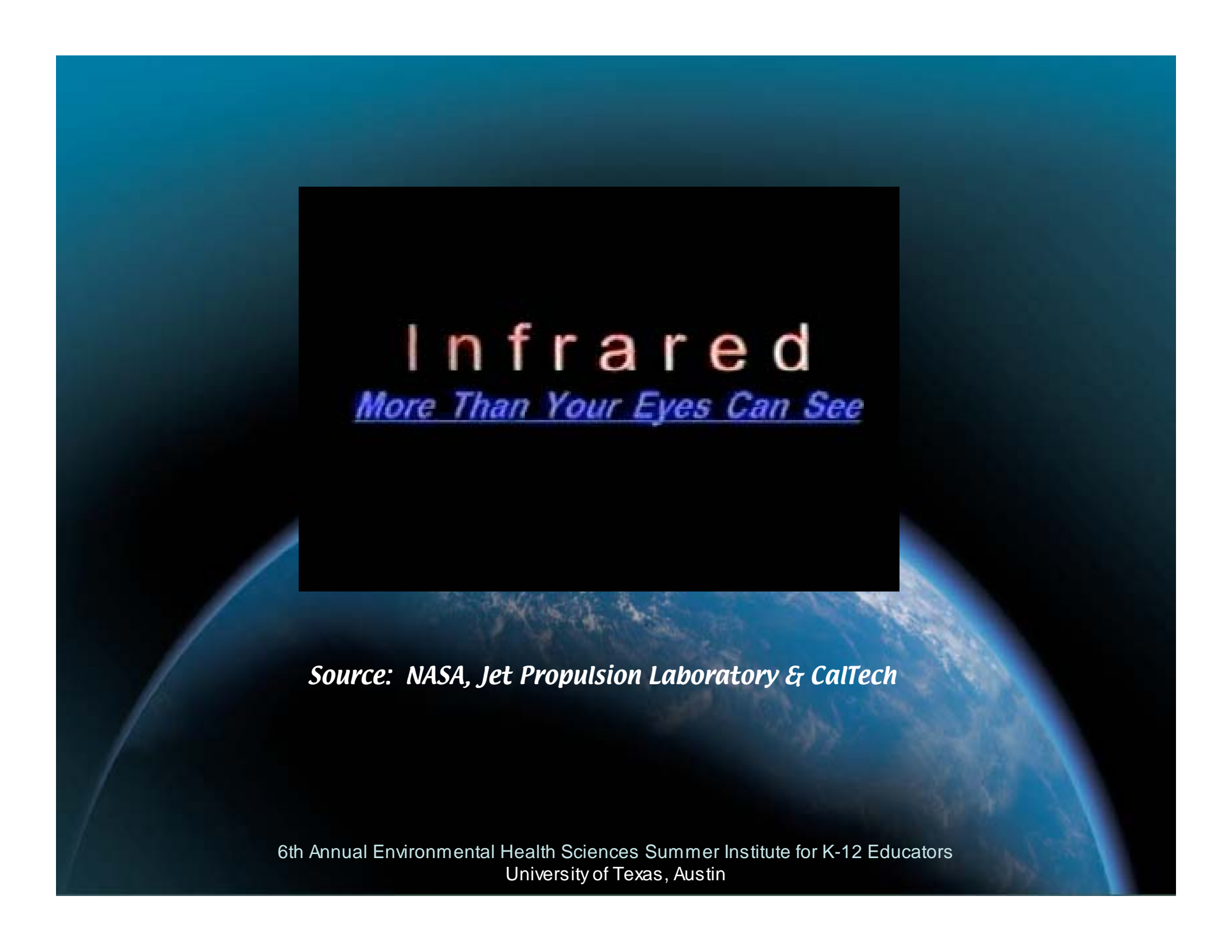
Ultraviolet Light



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*Albedo
Zebra
Stripes!*



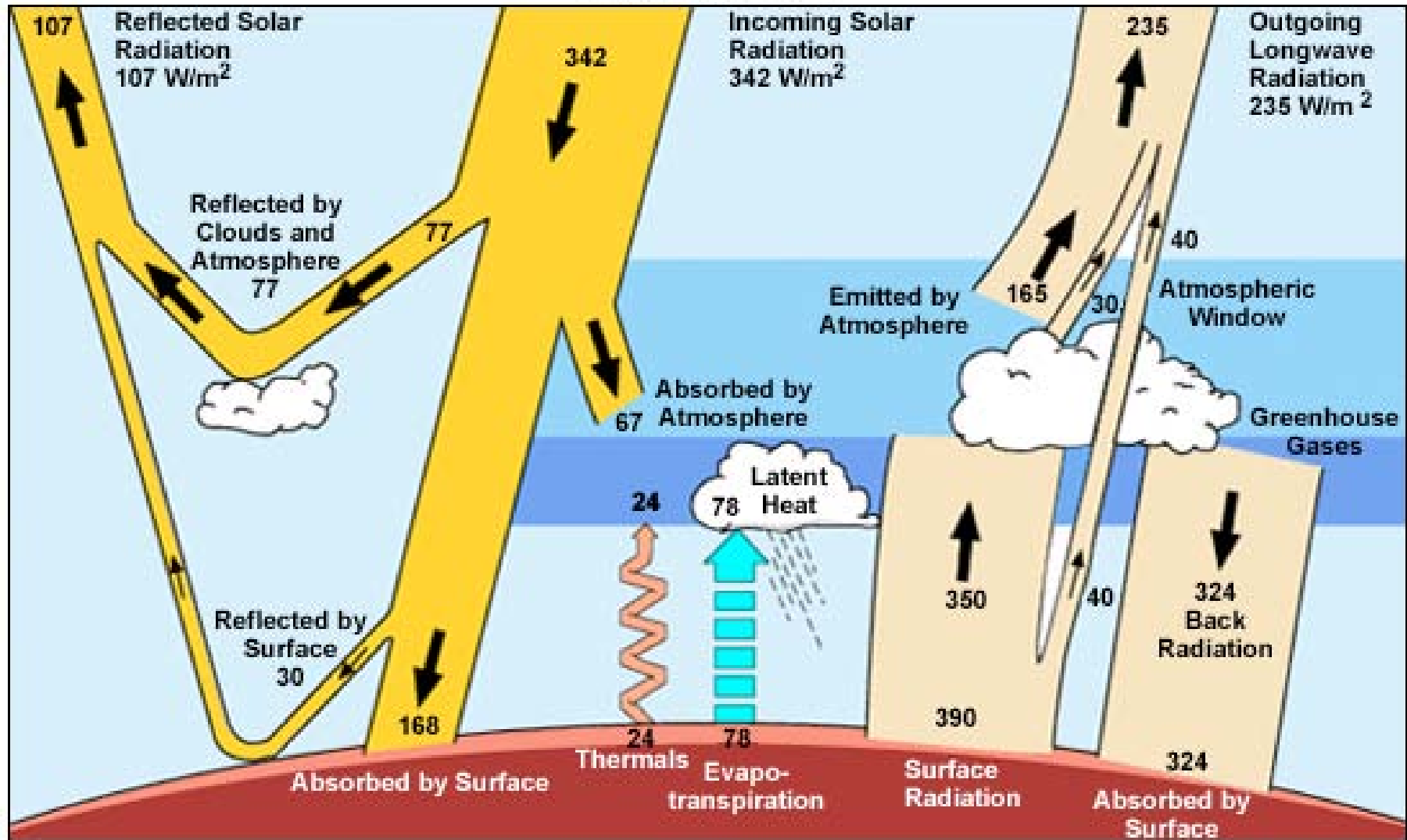
Infrared

More Than Your Eyes Can See

Source: NASA, Jet Propulsion Laboratory & CalTech



Global Heat Flows



Kiehl and Trenberth 1997