Windows to the Universe Program CMMAP Resources and Activities

Susan Foster and Randy Russell

CMMAP Team meeting

July 28 – 31, 2009

Ft. Collins

www.windows.ucar.edu

Overview

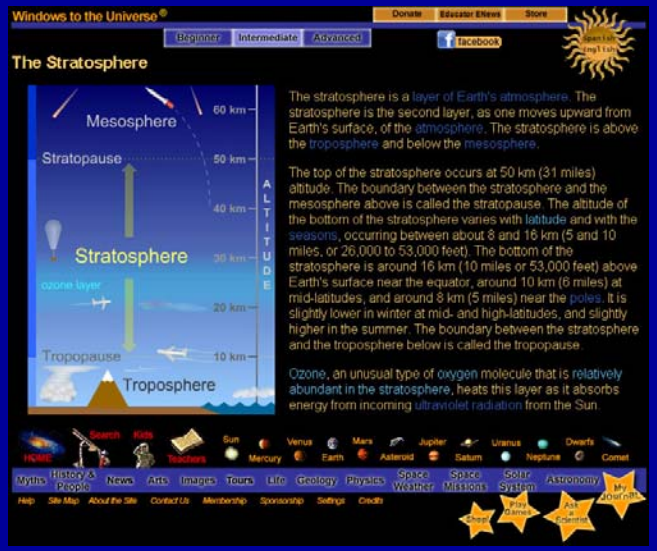
Creation of web-based K-12 and public education resources on the Windows to the Universe (W2U) web site

Focus on clouds, weather, climate and modeling

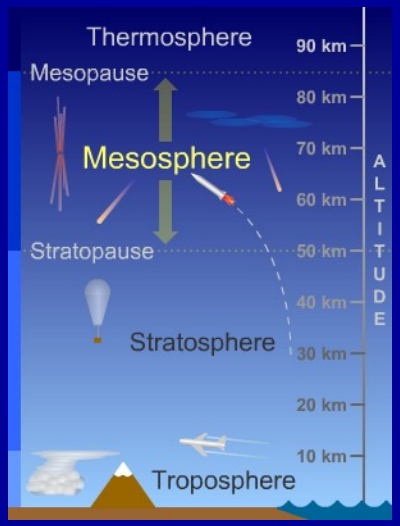
- 313 web pages developed or updated since 2007
- Six K-12 activities and teacher guides (including two microworlds)
- CMMAP-W2U web portal collections

Integrated Resource Development Components Example: Atmosphere Layers & Virtual Ballooning

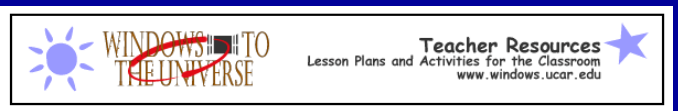
Content pages



Graphics



Teachers guide



Title:	**Virtual Ballooning to Explore Earth's Atmosphere**
Summary:	Students will use software to launch virtual weather balloons and collect data about Earth's atmosphere.
Source:	*Windows to the Universe activity by Randy Russell. Available online at: www.windows.ucar.edu/tour/link=/teacher_resources/graphs /teach_balloon_atmostrata.html*
Grade level:	6-12
Time:	1 hour
Student Learning Outcomes:	• Students will be able to describe how temperature and air pressure vary with altitude in Earth's atmosphere. • Students will design a research plan and make decisions in the process of conducting a simple experiment or "research project". • Students will learn about layers of Earth's atmosphere, electromagnetic radiation, the ozone layer, and the Greenhouse Effect.
Lesson format:	Computer and paper-and-pencil based activity.

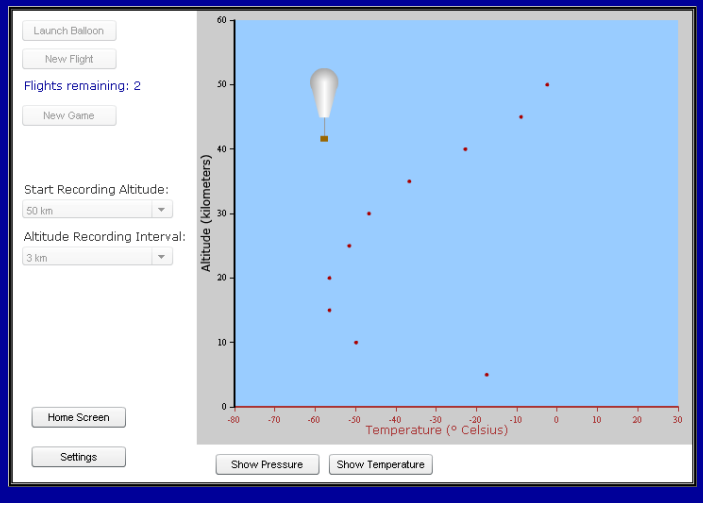
MATERIALS:

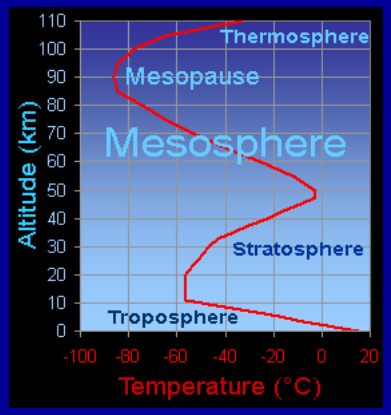
- computer with Internet (web) access and Adobe Flash plugin/player
- pencil
- student worksheet

DIRECTIONS:

1. Ask students what they already know about the atmosphere. Prompt them especially to share their knowledge about layers of Earth's atmosphere and how they think temperature and pressure vary with altitude. This could include having them draw from personal experience ("Last summer my family went on a vacation to the mountains... I was surprised to see snow in June... we kept getting out of breath while hiking.")
2. Decide whether and how you want to divide up students into groups or teams for this activity. Students can do the activity individually; however, group work could lead to interesting planning discussions between students. Especially if you have few computers, you could have a single group do the planning for just one balloon flight in a series of flights.

Microworld experiment





W2U CMMAP Resource Dissemination

Web site visitors

Since 2007

- 4,058,201 page views (26.4 % in Spanish)
- 3,075,422 visitors (25.2% to Spanish)

K-12 professional development workshops

- **Boston (Mar 2008) 35 teachers**
- **Portland (Nov 2008) 25 teachers**
- **Cincinnati (Dec 2008) 34 teachers**
- **New Orleans (Apr 2009) 17 teachers**
- **Colorado - NCAR Mesa Lab (ongoing)**

UCAR Education and Outreach Online Courses

Main Menu
Site news

- **~10-20 teachers per session**
- **4 sessions of 3-course sequence/yr since 2008**

Course categories

- ASTC C3
  - ASTC Climate Discovery: Climate Change for the C3 Community
- Climate Discovery
  - Introduction to Earth's Climate (Summer 2009)
  - Earth System Science: A Climate Change Perspective (Summer 2009)
  - Understanding Climate Change Today (Summer 2009)
- Course Archive
  - 2009
    - Introduction to Earth's Climate (Winter 2009)
    - Understanding Climate Change Today (Winter 2009)
  - 2008

Presentations at AGU, AMS, ASTC Conferences

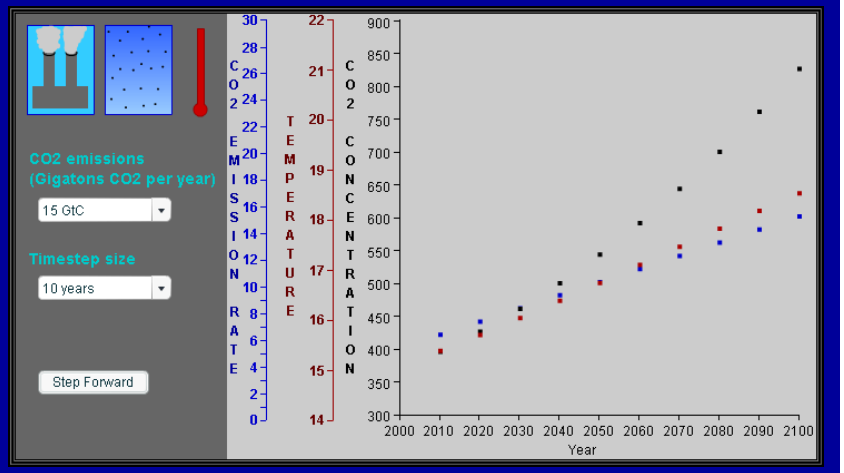
Balloon Atmostrata: Home

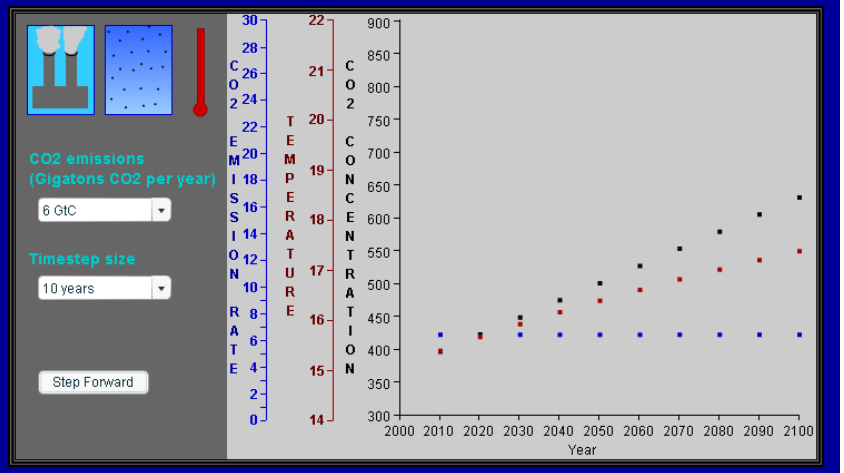
Play Game

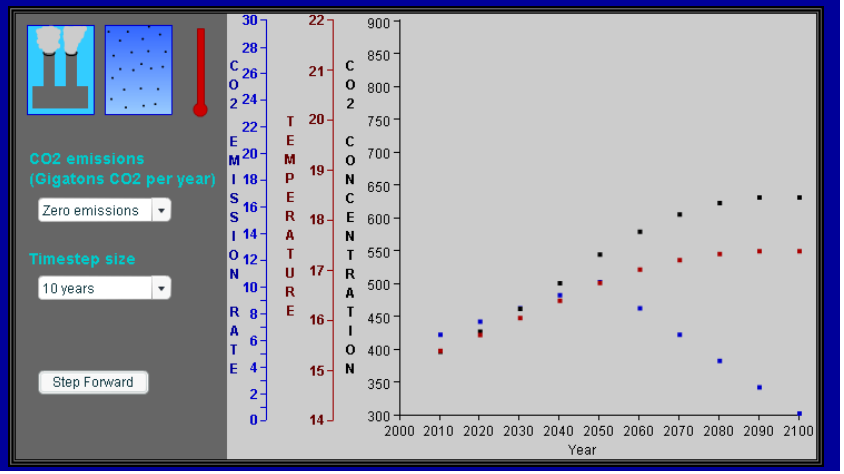
Instructions

Settings

Example: Very Simple Climate Model







- Activity guide for teachers
- Background content on W2U about climate modeling
- Disseminated via W2U web site, NSTA workshops, and NCAR Climate Discovery online course

Content Highlight

Center for Multiscale Modeling of Atmospheric Processes

CMMAP

Reach for the sky.

Colorado State University

Clouds | Weather | Climate | Models | Atmosphere | About CMMAP | People | Arts & Culture | Educators | Fun & Games

Spanish English

Windows to the Universe | Beginner | Intermediate | Advanced | Donate | Educator ENews | Store

Atmospheric Optics

Anti-crepuscular rays are bean
converge on a point opposite t
crepuscular rays, but are seen
Anti-crepuscular rays are most
sunset. This photo of anti-crep
Boulder, Colorado. Crepuscula
than anti-crepuscular rays.
Click on image for full size (42
Image Courtesy of Carlye Calvi

A Photo Album of Atmosp

Atmospheric Optics Image

Ventanas al Universo ®

Apóyanos | Boletín Maestros | Tienda

Principiante | Intermedio | Avanzado

Español Inglés

Óptica atmosférica

Los enlaces en color anaranjado lo llevan a páginas en Inglés aún no traducidas al Español.

Los rayos anti-crepusculares son rayos de luz solar que parecen converger en un punto opuesto al Sol. Son similares a los rayos crepusculares, pero se ven en el cielo opuestos al Sol. Los rayos anti-crepusculares son frecuentemente vistos durante la salida o puesta del Sol. Esta foto de rayos anti-crepusculares fue tomada durante una puesta de Sol en Boulder, Colorado.
Generalmente, los rayos crepusculares son mucho más brillantes que los rayos anti-crepusculares.
Haz "click" en la imagen para una vista completa (42 Kb)
Imagen cortesía de Carlye Calvin

¿Alguna vez has visto nubes en el cielo que se vean diferente a las nubes "normales"?, ¿alguna vez te has preguntado por qué se forman los arcoiris? A veces hay fenómenos en el cielo que son afectados por la luz y hacen que las nubes y la atmósfera se vean muy coloridas o con una apariencia única. La óptica atmosférica nos muestra cómo se comporta la luz cuando pasa a través de la atmósfera. Desde los arcoiris hasta las auroras, estas características ópticas son dinámicas y permiten que aprendamos sobre las condiciones atmosféricas. Algunos de estos fenómenos se ven a menudo, otros pueden ser espectáculos que se ven una sola vez en la vida.

A veces, el polvo, pequeñas partículas, y gotitas de humedad dispersan la luz para hacer que los rayos del Sol sean visibles mientras que en comparación, las nubes y las sombras de las montañas son oscuras, originando *rayos crepusculares* o *rayos anti-crepusculares*. En otros casos, el aire y partículas muy pequeñas pueden dispersar colores selectivamente para hacer que el cielo sea azul o que las puestas del Sol parezcan estar prendidas en llamas. Las nubes brumosas y la niebla contienen minúsculas gotitas de agua que producen extraños efectos ópticos que son sobre todo anillados y de colores brillantes, incluyendo las *nubes iridiscentes* y la *gloria*. Los minúsculos cristales de hielo en la atmósfera pueden crear *halos* tras refractar y reflejar la luz.

Hay gran cantidad de hermosos ejemplos de luz y de color que trabajan en la atmósfera. Visita el foto album de óptica atmosférica y la galería de imágenes de óptica atmosférica para ver imágenes de muchos tipos de estos fenómenos, así como información sobre cómo se forman.

Photo Album

Rayleigh Scattering
At sunrise or sunset, the sky may appear red because blue light is scattered out as the sunlight passes almost horizontally through the atmosphere. This image of Rayleigh Scattering was taken at sunrise at Elephant Butte, New Mexico.

Image Courtesy of Carlye Calvin

Silver Lining
A silver lining, which sometimes can be seen when the sun is behind a dark cloud, is the bright outline along the edge of the cloud. This effect occurs when the sunlight is diffracted by the cloud droplets around the edge of the cloud, and is the reason for the saying "every cloud has a silver lining." Crepuscular rays are also visible in this photograph.

Image Courtesy of Carlye Calvin

Sun Pillar

Aurora Borealis
Solar winds and other forms of solar activity are responsible for luminous streams of light known as the aurora borealis (northern lights), which appear in the sky mostly over polar latitudes. Charged particles streaming from the sun encounter gases in the Earth's upper atmosphere. These gases, mostly oxygen and nitrogen, are excited by the particles and, as a result, glow like a neon light.

Image Courtesy of University Corporation for Atmospheric Research

Earth - Atmosphere - Atmospheric Optics

Image Gallery

This image of a double rainbow was taken in

A green flash can be seen at sunrise and

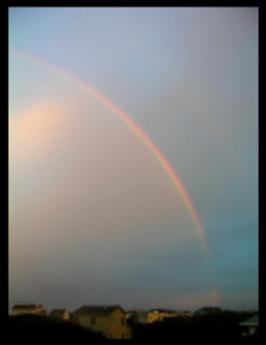
A sun pillar is a glittering vertical shaft of

A silver lining, which sometimes can be

At sunrise or sunset, the sky may appear red

A full rainbow with anticrepuscular rays

When direct sunlight strikes falling rain, a ...



For a rainbow to form, water droplets must be

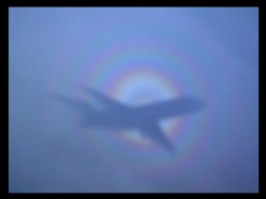
This photograph shows polar stratospheric

These mystifying clouds are called Polar

A perhelia (sun dog) is a bright patch or ...

Patches of cloud occasionally develop

Halos form when light from the sun or moon is



This photograph was taken from the window

Crepuscular rays poking through clouds

Content Highlight - Hurricanes

Windows to the Universe®

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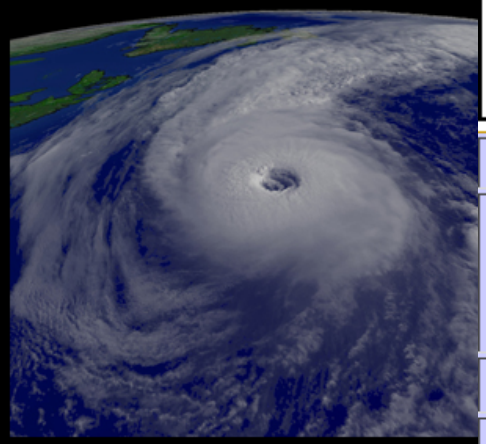
Spanish English

Hurricanes (also known as Tropical Cyclones)



Hurricane Alex, a category 3 storm at its stronge
north along the east coast of North America in A
causing flooding, strong waves, and rip tides alo
coast.
Click on image for full size (305 Kb)
Courtesy of NOAA

Hurricanes usually happen at a particular time
the world. In the North Atlantic, hurricane seas

Hurricane Image Gallery

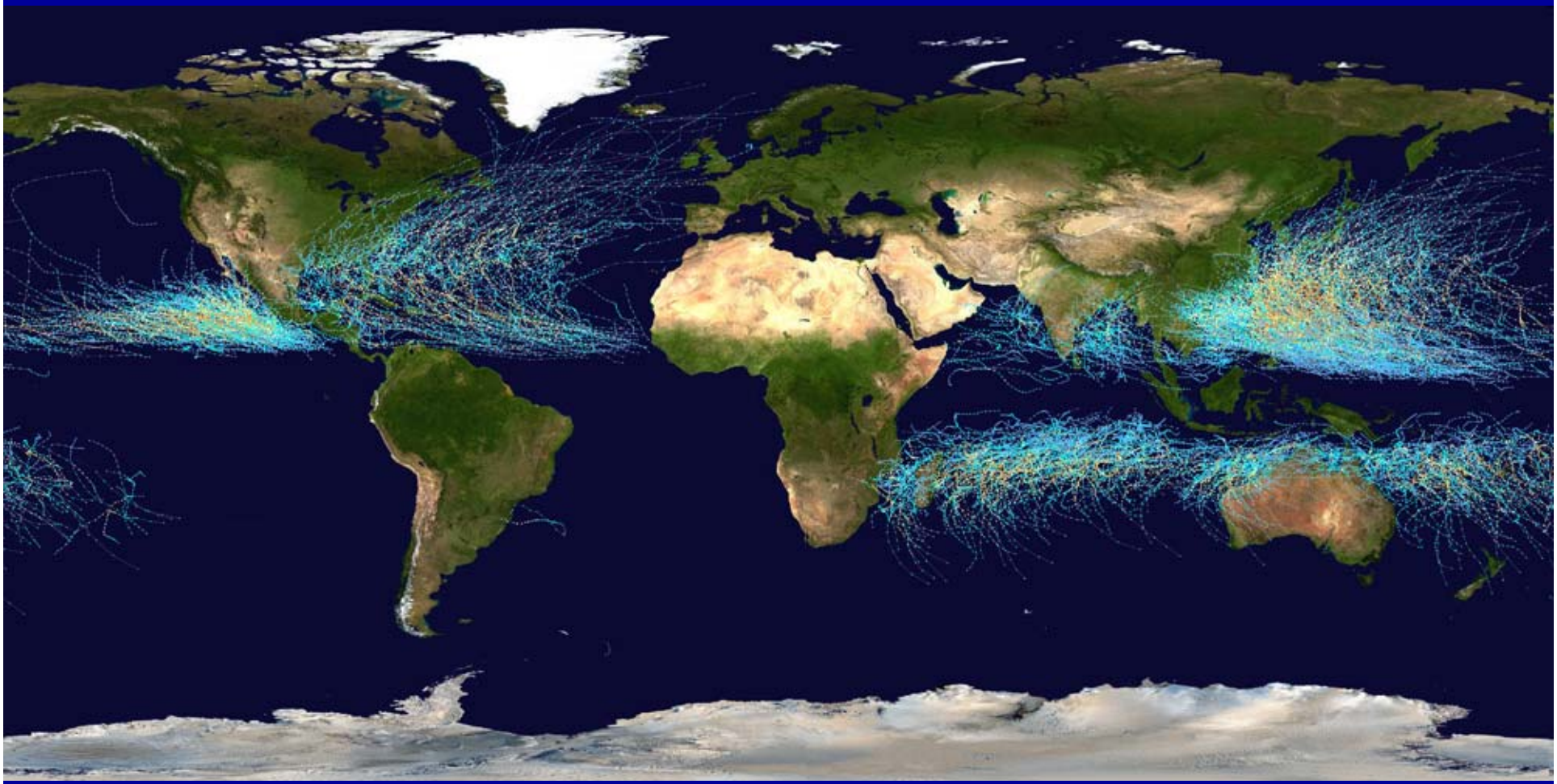
Are Hurricanes Becoming Stronger and M

WINDOWS TO THE UNIVERSE

Teacher Resources
Lesson Plans and Activities for the Classroom
www.windows.ucar.edu

Title:	**Hurricanes and Climate**
Summary:	Students investigate maps and data to learn about the connections between hurricanes and climate including (1) regional climate conditions where hurricanes form and (2) how global climate change may be affecting hurricanes.
Source:	A Windows to the Universe activity by Lisa Gardiner
Grade level:	6 - 9
Time:	Two to three class periods
Student Learning Outcomes:	• Students will be able to describe the 6 regions where hurricanes happen. • Students will graph and interpret data to learn that different regions have varying numbers of hurricanes. • Students will be able to explain that hurricanes happen during the warmest times of year and in regions that have warm sea surface temperatures. • Students will graph and interpret data about how hurricanes have changed over recent decades as

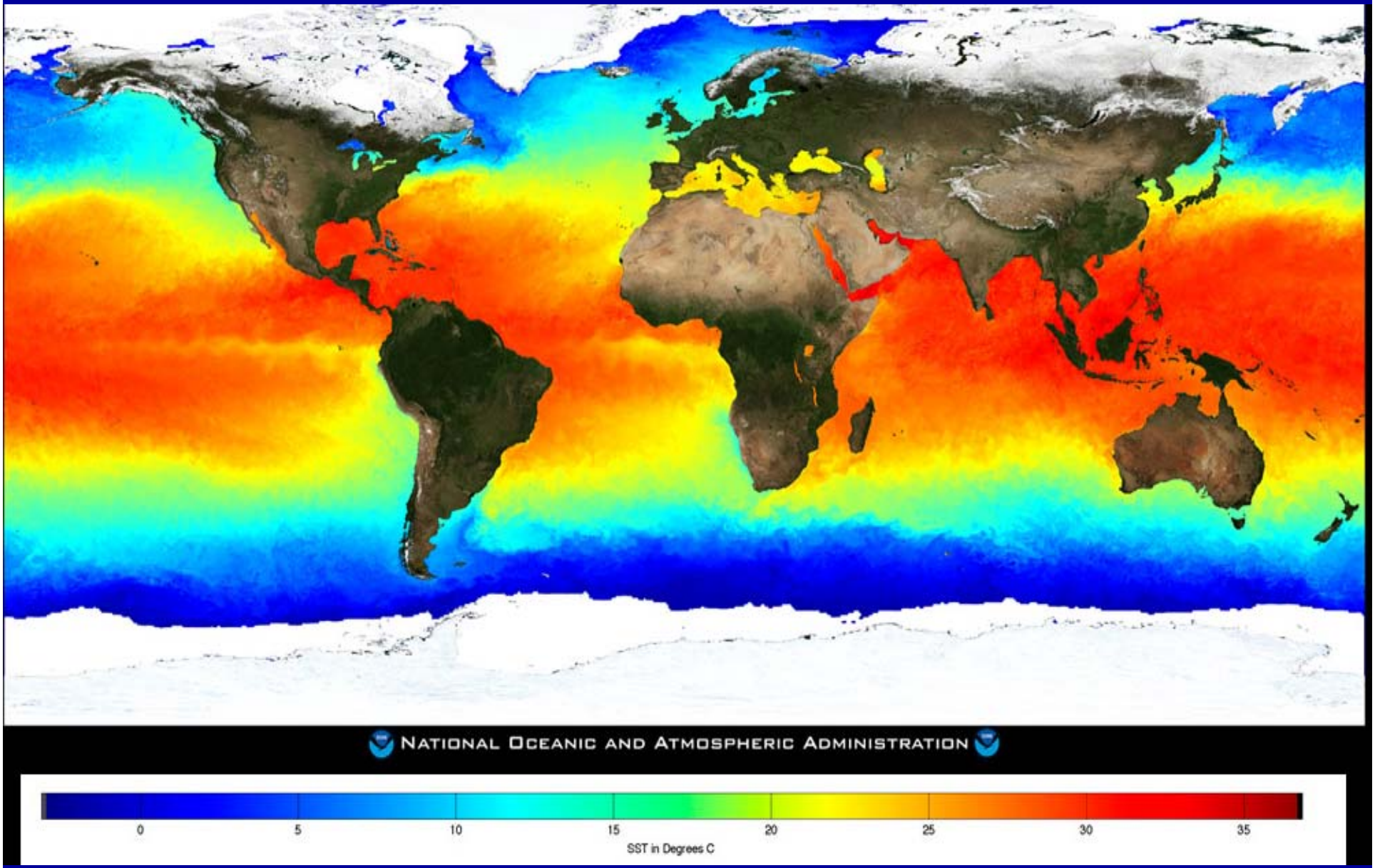
Map of Tropical Cyclones (1985-2005)



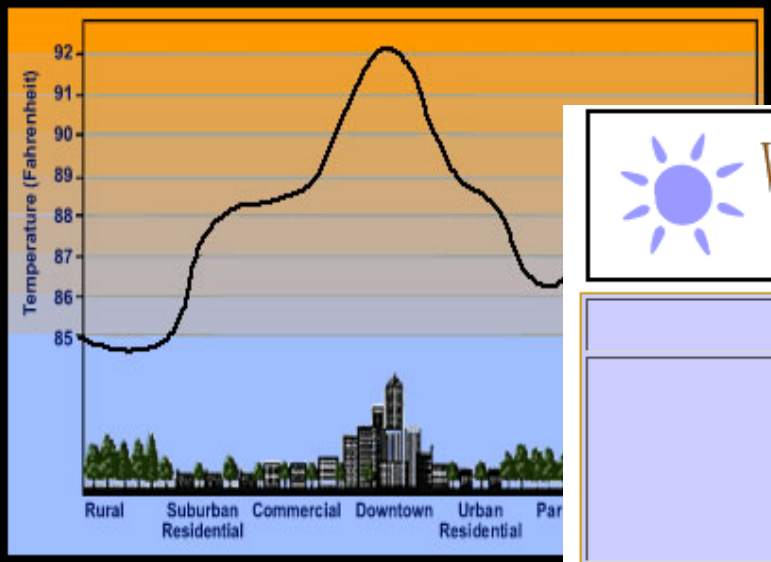
The map above shows the paths of all tropical cyclones that occurred between 1985 and 2005. Tropical cyclones are also known as hurricanes. The color of each path indicates the strength of the storm (according to the Saffir-Simpson Hurricane Scale). See key at left.

Courtesy of Wikipedia Commons

Map of Sea Surface Temperature (1985-2005)



The Urban Heat Island Effect



**This cross section through a typical city shows h
are usually lower at the urban-rural border than
downtown areas.**
Click on image for full size (74 Kb)
***Lisa Gardiner / Windows to the Universe, based
the Lawrence Berkeley National Laboratory***

The air in urban areas can be 2 - 5°C (3.6 - 9°F) warmer than nearby rural areas. This is known as the urban heat island effect. It's most noticeable when there is

Today, many cities are making an effort to co
Trees are being planted along city streets. An

Urban Weather

WINDOWS TO THE UNIVERSE

Teacher Resources
Lesson Plans and Activities for the Classroom
www.windows.ucar.edu

Title:	**Feeling the Heat**
Summary:	Students learn about the urban heat island effect by investigating which areas of their schoolyard have higher temperatures. Then they analyze data about how the number of heat waves in an urban area has increased over time with population.
Source:	A Windows to the Universe activity by Lisa Gardiner
Grade level:	6 - 10
Time:	2 class periods
Student Learning Outcomes:	• Students investigate how trees, grass, asphalt, and other materials affect temperature. • Based on their results, students hypothesize how concentrations of surfaces that absorb heat might affect the temperature in cities - the urban heat island effect.

Connecting Clouds and Weather to Humanities

Clouds in Art

- Interactive, PPT presentation
- Image gallery
- Activity

John Constable (1776-1837), Weymouth Bay

Our Poetic Planet

- 16 poems about clouds, rainstorms, wind, water
- Poets include: Pablo Neruda, Stevinson, Dickinson, Frost, Shakespeare, Shelley, Bronte, Longfellow, Elias, Emerson, Sandburg, etc.

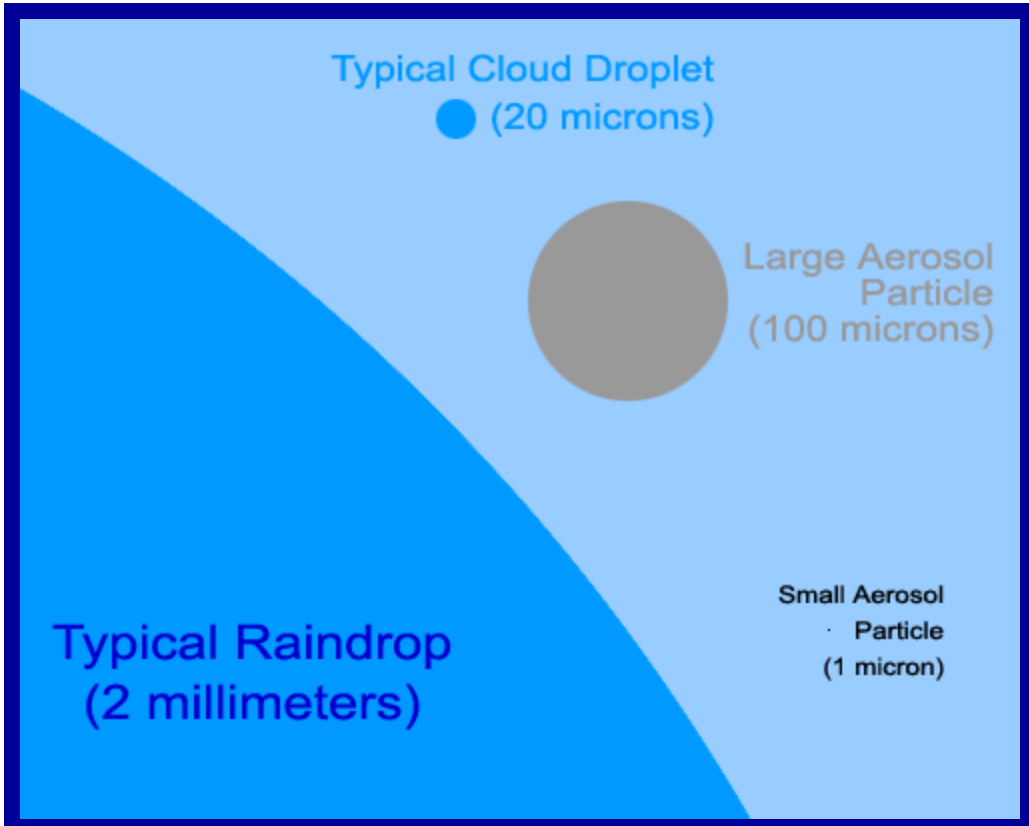
Claude Monet, Field of Poppies, 1873

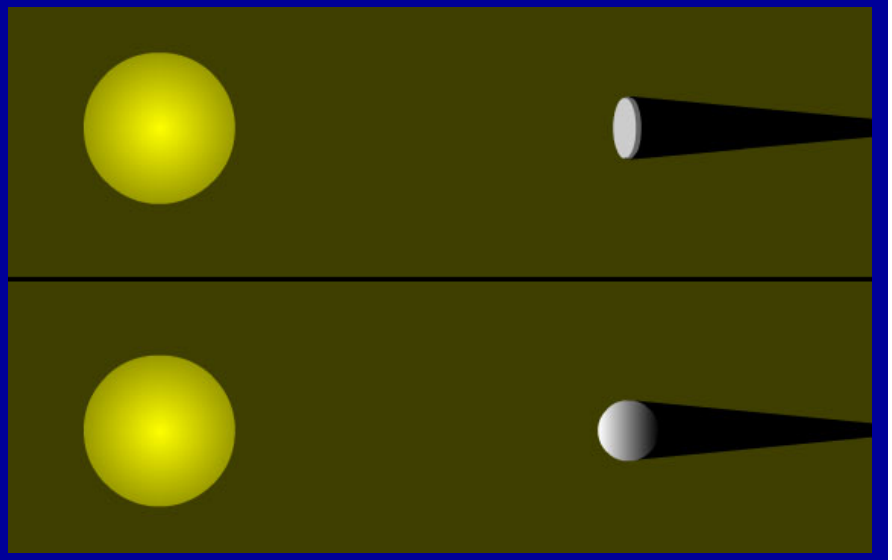
Mythology

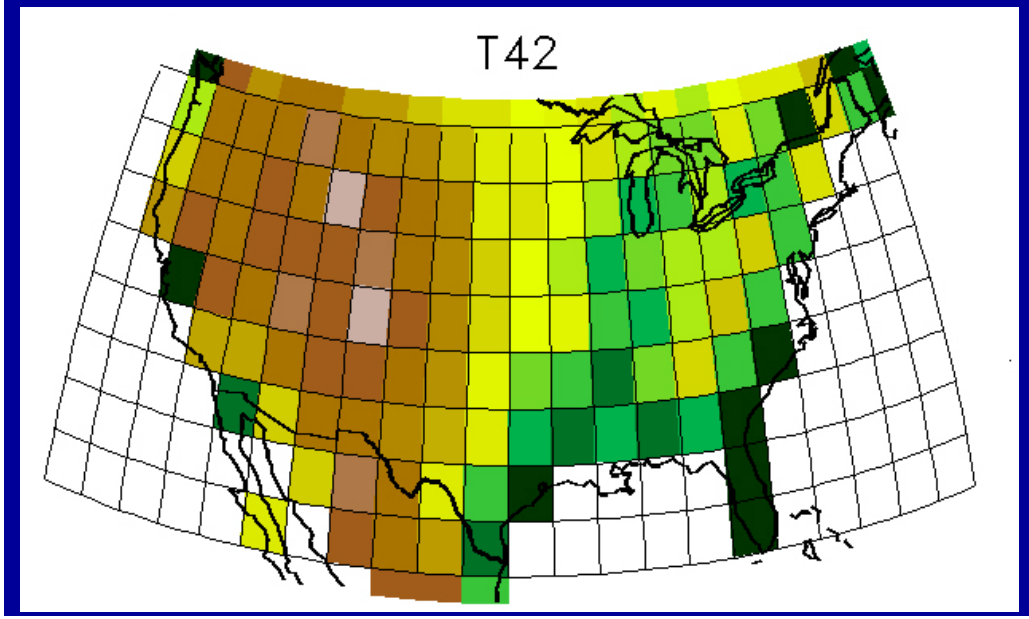
Greek, Aztec, Mayan, Norse, African, Japanese, Maori, Navajo,

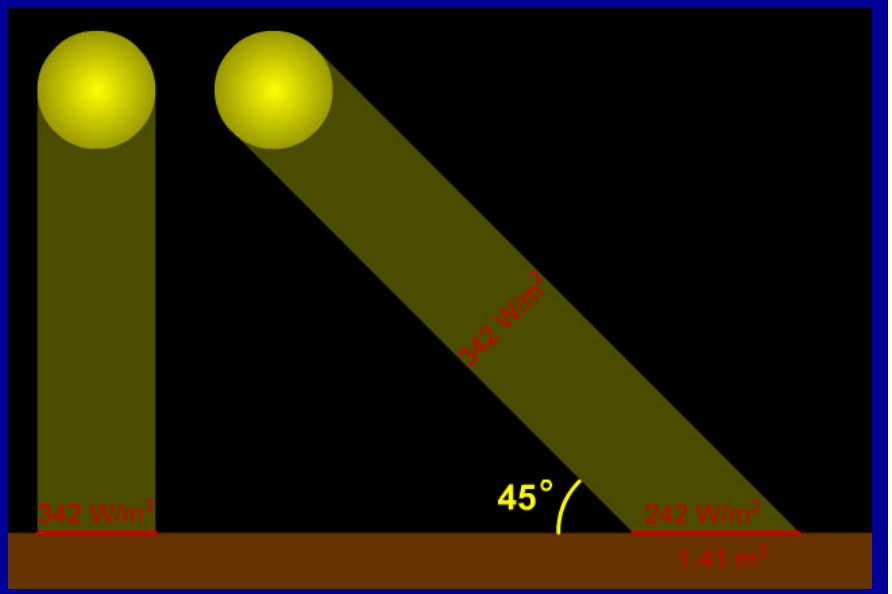
Ceramic vessel shows Tlaloc, the Aztec rain god. From Great Temple of Tenochtitlan in Mexico. Museo del Templo Mayor, Mexico.

Graphic Resources

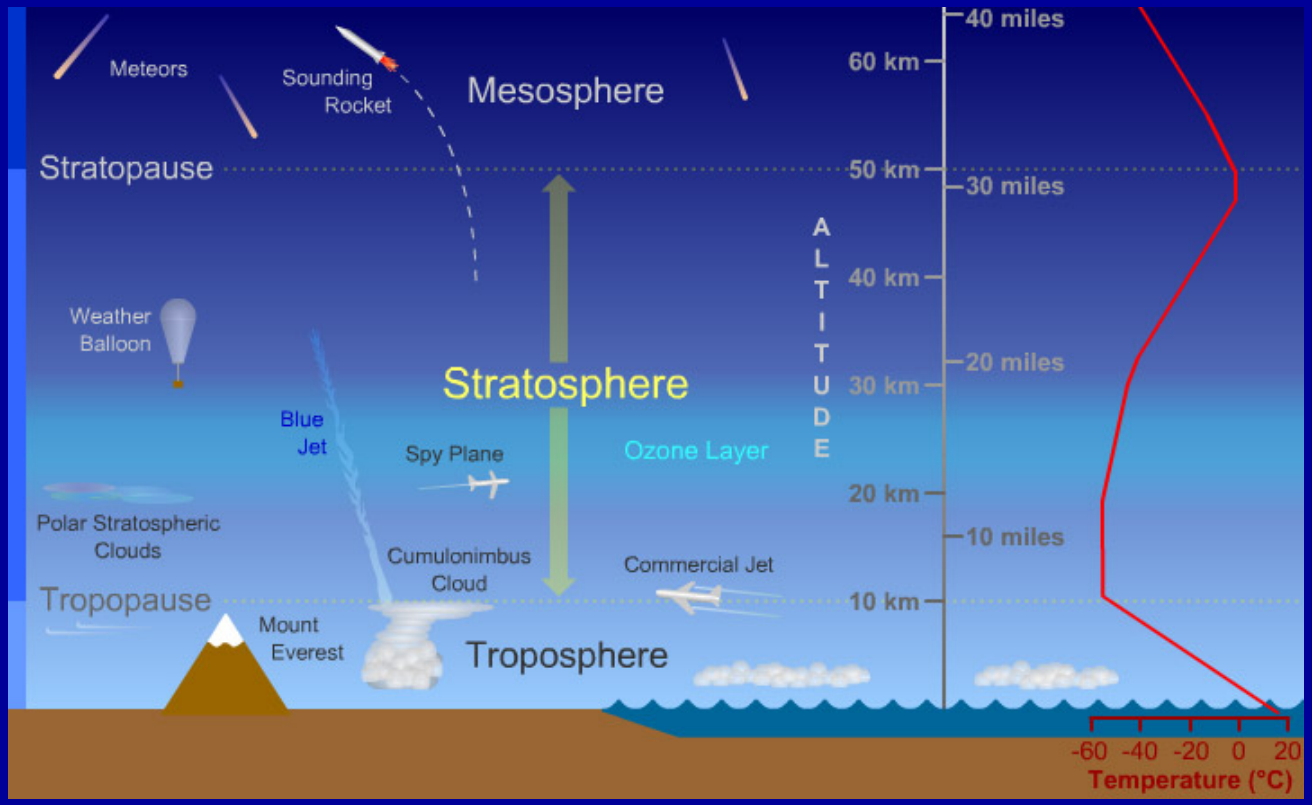


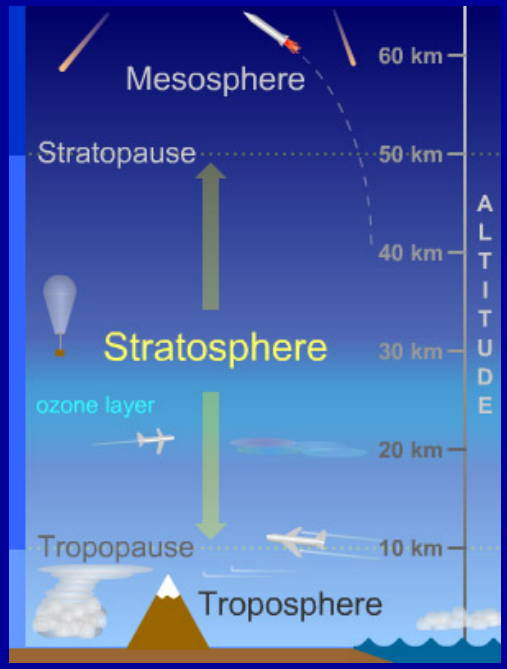




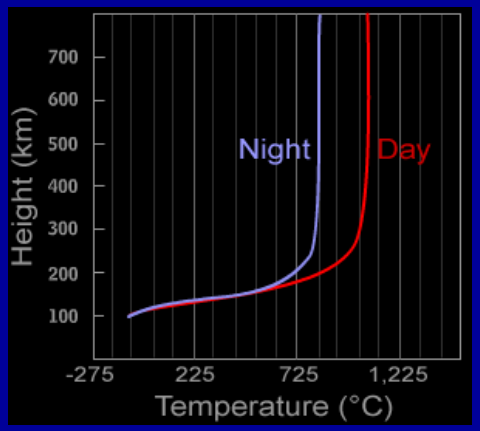


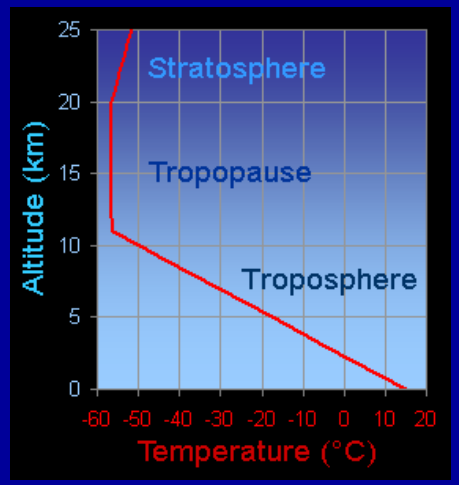
Atmosphere Diagrams



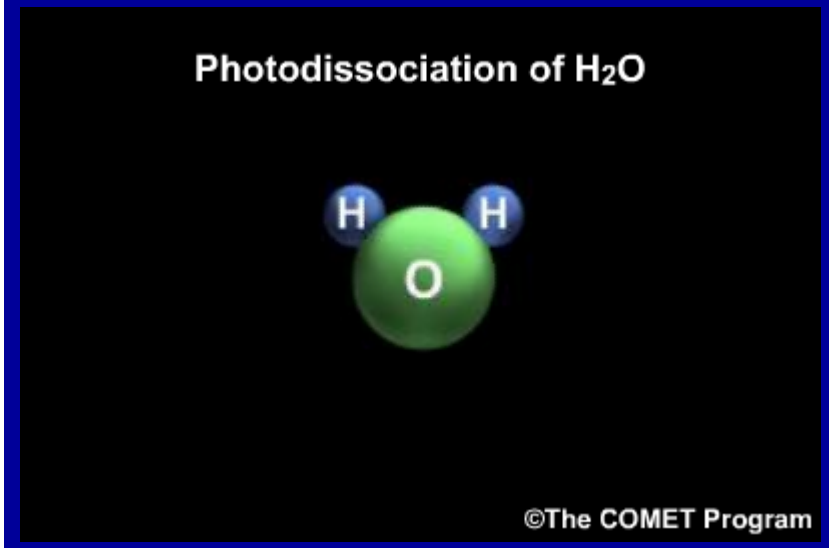


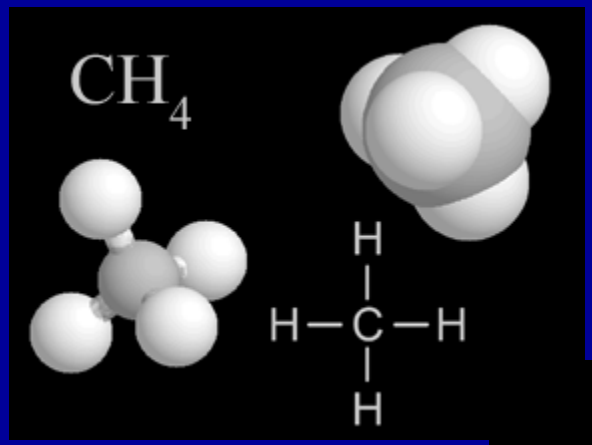
- Large and small versions
- Version for each layer (troposphere, stratosphere, mesosphere, …)
- Shows “hallmark” features, phenomena found in each layer

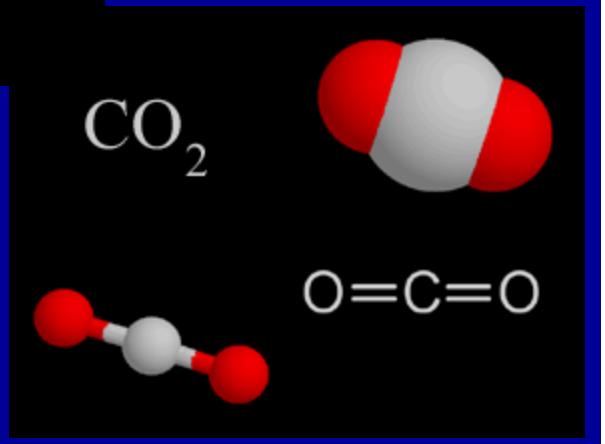


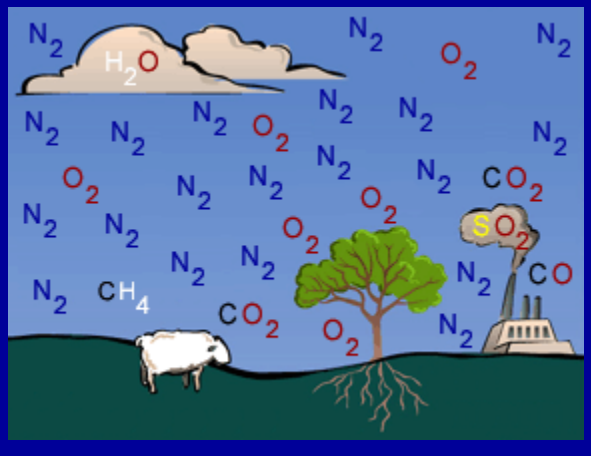


Atmosphere Chemistry



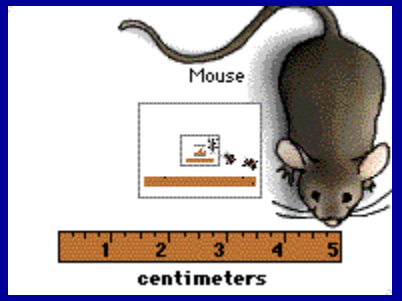






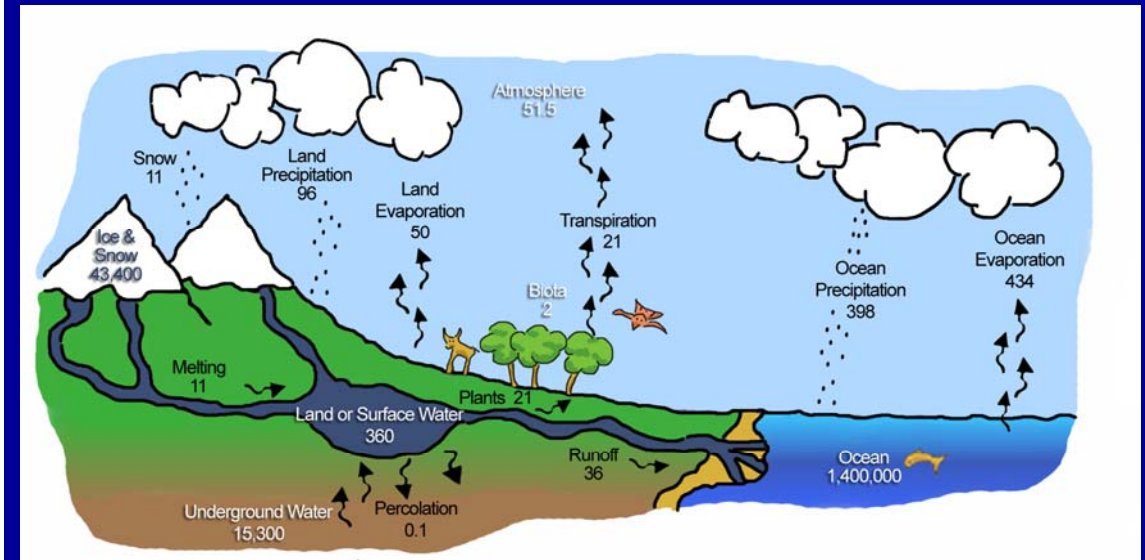
Interactive Display of IPCC Graphics

Future?

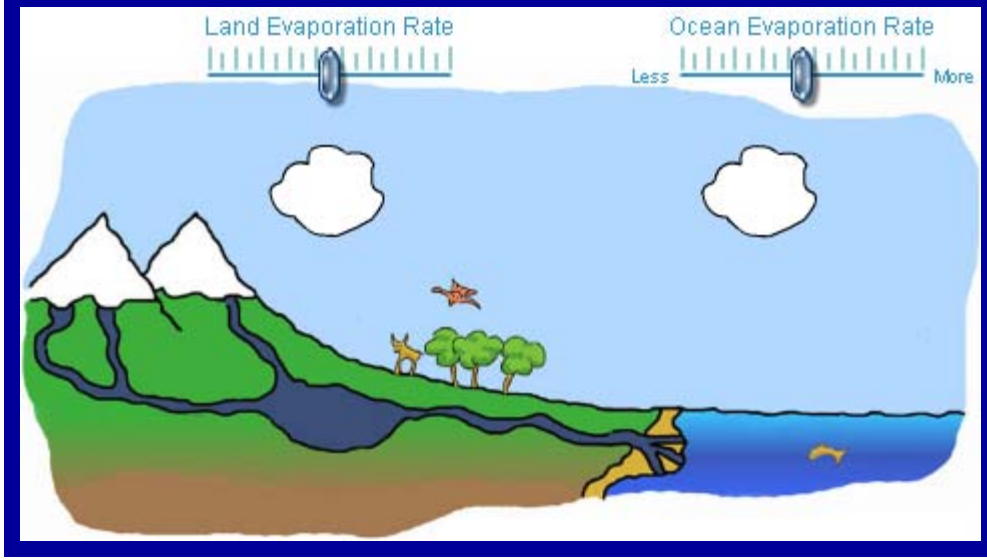


- Zooming in and out… to convey scales of multiscale phenomena.
- Perhaps animations to illustrate “How do raindrops form?”, “How do snowflakes form?”, “How do clouds form?”

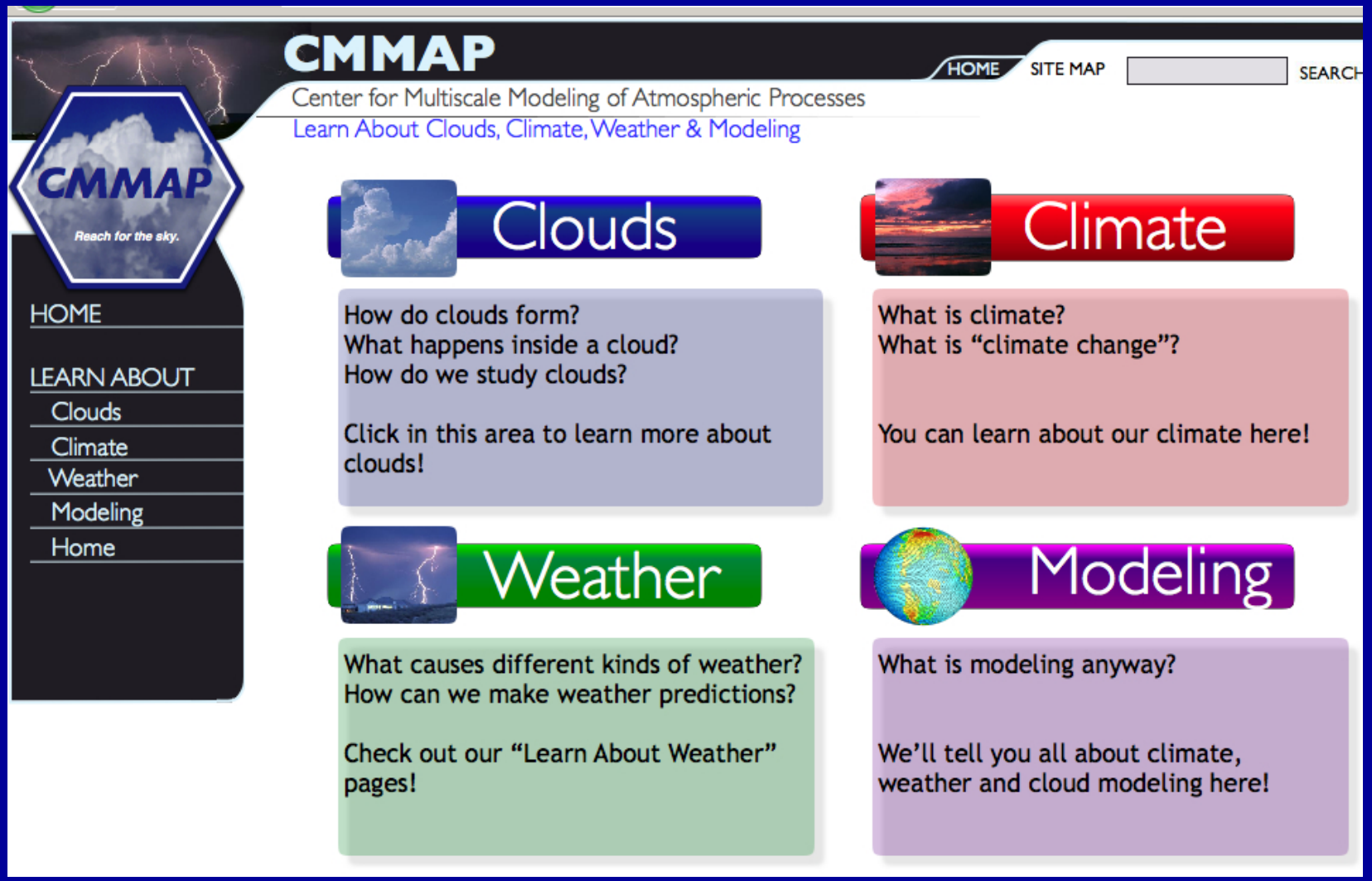
Water Cycle Animated Diagram



… with info (reservoir size or flow rate) that pops up when item is clicked on.



Interpret more CMMAP research for W2U audiences



Disseminate CMMAP summer course content

CMMAP

Center for Multiscale Modeling of Atmospheric Processes

Science and Education

HOME | SITE MAP | SEARCH

Weather and Climate for Teachers
2009 Summer Teacher's Course

- HOME
- SCIENCE-ED HON
- FOR STUDENTS
  - Current
  - Prospective
  - Internships
  - Scholarships
- FOR TEACHERS
- EVENTS PAGE
- CALENDAR
- DIVERSITY
- LINKS

Cloudy Day: Hands-on and Online Classroom Adventures Bridging Basic Weather Science to Literacy, Arts, and ELL

Occasionally altocumulus clouds show vertical development and produce tower-like extensions. These altocumulus clouds are in the early stages of development.
Click on image for full size (41 Kb)
Courtesy of UCAR Digital Image Library

Welcome to the online resources for out NSTA workshop entitled Cloudy Day! This web portal is intended to provide links and additional information to those who attended our workshop at a recent NSTA conference.

Workshop Resources

Presentation (14.1MB PowerPoint file)

Activities:

Cloud in a Bottle

Cloud Viewer (760K PDF)

Clouds in Art

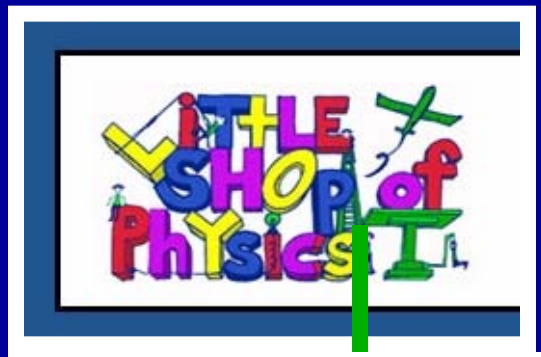
Our Poetic Planet

Additional Resources

The Clouds section of Windows to the Universe

Cloud Types

Disseminate LSOP Videos and Activities on W2U (changingclimate@CSU videos, too?)



Episodes

Epi #1: Pressure
In our first edition of Everyda
studio to learn all about the
gallon drum, force= P x A, Be
mini marshmallow masher.

Epi #2: Energy
Brian Jones brings students i
Brian explores different forms
nuclear. Highlights include: d
peanuts, and cooking a hot d

Epi #3: Boiling & Freezin
In this episode, we explore th
surprising properties. Highligh
balloon in a bottle, and super

Epi #4: Sinking & Floatin
This episode was all about th
looked at ways to make bowl
packets all float and sink. So
ice, making helium bubbles,

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Check out this collection of videos from the National Science Foundation (NSF) covering a broad range of scientific topics!

Secrets of Plant Genomes Revealed!
This lively look at the field of plant genetics explores how plants got to be the way they are and ways science may help us make better use of plants in the future.
Length: 24 minutes
Date: August 31, 2007

The History of Early Polar Exploration
This talk by Donal Manahan of the University of Southern California describes scientific aspects of early polar exploration.
Length: 11 min. 48 sec.
Date: August 30, 2007

Star Wars: Where Science Meets Imagination - Museum Exhibit
This museum exhibit explores the science behind the "Star Wars" movies. Want to learn more? Check out this Press Release.
Length: 1 min. 46 sec.
Date: April 24, 2007

Evolution Hits the Beach
A lively, informal look at a fossil that may represent the first vertebrate to emerge from the ancient seas, discovered by scientists from the University of Chicago, Harvard University and the Academy of Natural Sciences in Philadelphia.
Length: 1 min. 7 sec.
Date: November 2, 2006

Genetics of Self-Sacrifice
A lively, informal look at animal research by scientists from UC-Santa Cruz. They
Length: 1 min. 19 sec.
Date: November 2, 2006

Thank you!

We look forward to focusing our efforts with your input in the coming years!