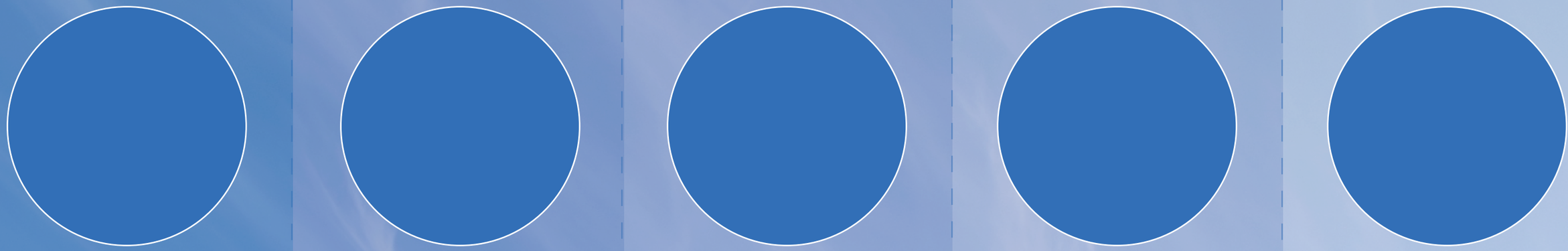
National Aeronautics and Space Administration

SKY CONDITIONS

The amount of aerosols in the atmosphere affects our sky conditions. Most aerosols are too small to see but we can observe their impacts by observing and categorizing sky color and visibility. Observing these parameters helps us to understand how aerosols reflect, refract, and absorb energy entering and leaving the Earth's atmosphere.

*Each circle represents the conditions of an unusually clear, deep blue sky. The addition of drops of milk into the water represents an increasing amount of aerosols in the atmosphere.



	Clear H2O, No Drop of Milk	~ .5 Drops of Milk	~1 Drop of Milk	~2 Drops of Milk	4 Drops of Milk
Sky Color	Deep Blue	Blue	Light Blue	Pale Blue	Milky
Aerosols	Low Number of Particles				High Number of Particles
Visibility	Unusually Clear	Clear	Somewhat Hazy	Very Hazy	Extremely Hazy

Helpful tips for observing sky conditions:

- When observing sky condition, look for something out of the ordinary. Different locations can have different common observations (commonly clear or commonly hazy).
- To get a good starting point for sky condition observations in your area, wait for a cold front or a storm to pass through. A cold front or a storm tend to "wash" the aerosols out of the atmosphere which will provide the clearest sky conditions for your area. It also helps to take a picture, as this will be a good comparison for later sky condition observations.

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Sky Conditions Activity

Activity Introduction:
In this activity, students discover the importance of sky observations to better understand the effects of aerosols on our atmosphere.

Audience: K-8
Resource Type: Activity or Demonstration
Learning Time: 15- 30 minutes
Instructional Strategies: Hands-on-learning; Inquiry Based Learning

Learning Objectives:
Student will:
- Learn that by observing sky color and visibility; one can see the impact of aerosols on the atmosphere.
- Learn that clouds and aerosols in Earth's atmosphere can be measured with observations through light/lasers/lidar.

Materials:
- S'COOL Sky Conditions Poster
- Clear Plastic Cups (suggested: 4'' Tall with a 2'' diameter base)
- Water
- Milk or Liquid Coffee Creamer
- Stirring Utensil
- Activity Procedure printout

Vocabulary:

Aerosol: Small liquid or solid particles dispersed in the atmosphere (man-made or naturally occurring). Large quantities are often regarded as pollutants in the form of haze and smoke. A low amount of aerosols in the atmosphere relates to unusually clear visibility and a deep blue-sky color. Visibility is extremely hazy and the sky color is milky when there are a lot of aerosols present in the atmosphere. (NASA Aerosol Fact Sheet- http://www.nasa.gov/centers/langley/news/factsheets/Aerosols.html)

Visibility: The classification of the clarity with which objects can be viewed through the intervening atmosphere is divided into 5 categories: Unusually Clear, Clear, Somewhat Hazy, Very Hazy, and Extremely Hazy.

Sky Color: The classification of the color of the sky into one of the following 5 categories: Deep Blue, Blue, Light Blue, Pale Blue, and Milky. Near the horizon it is typically lighter due to the presence of aerosols. The darkest part of sky can often be seen about half way between the horizon and directly overhead, in the "anti-sun" direction - that is, when you look at the sky with your shadow in front of you. When observing Sky Color you should classify the darkest (bluest) color of the sky (S'COOL Sky Color Chart- http://scool.larc.nasa.gov/skycolor.html)

Engagement: ***What can cause good or bad visibility in the atmosphere? Why?***

Background:
The sunlight that enters our atmosphere is composed of all the colors in the rainbow. When it hits the atmosphere, air molecules (water vapor, oxygen, nitrogen, CO2, and other trace gases) scatter the light, the color blue is scattered most effectively.

The light is also scattered and/or absorbed by particles dispersed in the atmosphere called aerosols. An aerosol can be "gas and vapors, mists and droplets, or tiny particles or material", such as ash. Aerosols can be anthropogenic (man-made) or naturally occurring.

The amount of aerosols in the atmosphere affects our sky conditions. Most aerosols are too small to see but we can observe their impacts by observing and categorizing sky color and visibility. A low amount of aerosols in the atmosphere relates to unusually clear visibility and a deep blue sky color. Visibility is extremely hazy and the sky color is milky when there are a lot of aerosols present in the atmosphere.

Observing these parameters helps us to understand our sky condition and make an educated guess about the amount of aerosols in our atmosphere.

Similarly, NASA's CALIPSO satellite relies on remote sensing measurements from a laser and the reflected light, a Lidar, to gather information about cloud aerosols and their affects on our atmosphere.

Sky Conditions Activity Procedure

Set up:
1. Place a plastic cup on each of the five blue circles on the poster.
2. Fill each cup with 1.5-2'' of water.
3. Starting with the second circle from the left, add increasing drops of milk to the cups as you move to the right on the poster. Add milk drops as instructed on the poster in black text under each circle.
4. Using a stirring utensil, mix milk well to achieve an even consistency.

   (*NOTE: You should have an increase of milky water as you move from left to right on the poster starting with clear water.)

*Additional Set Up Information:
1. It may help to use the first cup (clear water) and the last cup (milky water) to make the cups in between. For example:
   a. For the Light Blue/ Somewhat Hazy cup use a half and half mixture of the Deep Blue/Unusually Clear and Milky/Extremely Hazy cups.
   b. For the Blue/Clear cup use a half and half mixture of the Deep Blue/Unusually Clear and Light Blue/ Somewhat Hazy cups.
   c. For the Pale Blue/Very Hazy cup use a half and half mixture of the Light Blue/ Somewhat Hazy and Milky/Extremely Hazy cups.
2. Only fill cup to 1.5-2'', to decrease the chance of accidental spills and clean up.

Exploration: ***Have students observe and compare the "sky color" and "visibility" through each cup.***

1. To best observe the sky color parameter, view cup from the top. Look straight down into the cup to view the new color of the blue circle under the cup.
2. To best view visibility parameter, view cup from the top as well as the side. Look through the cup/liquid and compare the different cups side by side.

Questions:
1. What does the water and drops of milk stand for in each cup? (Water = Atmosphere, Milk = Aerosols)

2. In this activity, how does the increase of milk affect the water color and visibility? The cup of water represents our atmosphere. (Milky cup = Low/Hazy Visibility, Clear cup = high/clear visibility and blue sky)

3. What are some examples of these conditions in real life?(High amount of aerosols = pollution or smoke, Low amount of aerosols = clear day or after a storm/rain to wash the aerosols out of the air)

Explanation:
The amount of aerosols in the atmosphere affects our sky conditions. Most aerosols are too small to see but their impact can be observed by categorizing sky color and visibility. Observing these parameters help participants understand how aerosols scatter and absorb energy entering and leaving the Earth's Atmosphere.

Elaboration:
- S'COOL CALIPSO Activity: CALIPSO Profile of the Atmosphere (http://scool.larc.nasa.gov/lesson_plans/4_CALIPSO_Profile_of_the_Atmosphere.pdf)
- S'COOL Project, Report Form (http://science-edu.larc.nasa.gov/SCOOL/pdf/forme-ol.pdf)
- MY NASA DATA Lesson: Sky Color for Kids (http://mynasadata.larc.nasa.gov/804-2/sky-color-for-kids/)
- MY NASA DATA Lesson: What is Your Sky Color (http://mynasadata.larc.nasa.gov/what-color-is-your-sky/)

Evaluation:
Student understanding and completion of this activity can be used to formatively assess the topics of this activity (the affect of aerosols in the atmosphere, measured by sky color and visibility).

Sky Conditions Activity URL:
http://science-edu.larc.nasa.gov/SCOOL/pdf/Sky_Conditions_ActivityVer1.pdf

Students' Cloud Observations On-Line:
http://scool.larc.nasa.gov/