National Aeronautics and
Space Administration

Office of Human Resources and Education
Education Division

Educational Program	
Teachers/Students	Grades 5-12

NASA...ON THE CUTTING EDGE — EDUCATION VIDEOCONFERENCE SERIES

EXPLORATIONS IN SCIENCE, MATHEMATICS & TECHNOLOGY FOR PRE-COLLEGE EDUCATION

The Whole World in Your Hands

EOSDIS - The Earth Observing System Data & Information System

EDUCATION VIDEOCONFERENCE

Every day, Earth faces environmental change. Fluctuating variables–including climate, sea levels, El Niño, earthquakes, severe storms, deforestation, and ozone depletion–represent just a handful of many which shape and define our home, planet Earth.

This program challenges you to examine one component of worldwide efforts to understand and predict such change: NASA's Earth Observing System (EOS), an array of global observation satellites. Just in time for Earth Day, examine how the EOS Data & Information System (EOSDIS) controls EOS instruments to process, archive, manage, and distribute instrument data using one of the most complex computer networks ever developed.

The Global Hydrology & Climate Center in Huntsville, Alabama and the ECOlogic team from Gonzaga College High School in Washington, D.C. join us live for this interactive program.

Find out how you, as educators and students, can tap into these EOSDIS data centers from school computers to hold the whole world in your hands.

VIDEOCONFERENCE SCHEDULE

THURSDAY
MARCH 16, 1995

TEST SIGNAL.....3:30 - 4 PM EST

PROGRAM..... 4 - 5 PM EST

IN THIS PACKAGE

- MISSION TO PLANET EARTH PROGRAM PAMPHLET
- 2 LITHOGRAPHS
- EOSDIS FACT SHEET
- PRESENTER PROFILES
- SCIENCE EXCURSION
- MATH EXCURSION
- TECHNOLOGY EXCURSION
- ADDITIONAL LAB ACTIVITIES

SATELLITE COORDINATES

SATELLITE TELSTAR 302
TRANSPONDER 1H
CHANNEL 2
Downlink Frequency 3740 MHz
Audio 6.8 MHz
(May be simulcast on NASA TV)

ON - AIR DIALOGUE

(800) 852-0454

FOR DOWNLINK DIFFICULTIES

(405) 744-3486

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The NASA Education Videoconference Series is produced for NASA's Education Division by the Teaching From Space Program at Oklahoma State University (OSU), in cooperation with OSU's Educational Television Services and collaborating NASA centers, distance learning networks, and educational television providers.

Presenter Profiles

Dr. Robert Harriss is the Director of the Science Division in the Office of Mission to Planet Earth at NASA Headquarters in Washington, DC. His research and teaching interests include: global environmental research and policy, remote sensing, integrated resource planning, and environmental dispute resolution. Bob earned his undergraduate degree at Florida State University and his masters and doctorate degrees at Rice University. He has served as an assistant professor of geochemistry and limnology at McMaster University in Hamilton, Canada; as professor of oceanography at Florida State University; and as professor of Earth system science and natural resources at the University of New Hampshire. Additionally, Bob was a mission and project scientist on NASA's Global Tropospheric Experiment. The recipient of numerous fellowships and awards, he has published more than 160 research papers and abstracts in scientific journals.

Dr. Pete Robertson is a Space Scientist at NASA Marshall Space Flight Center in Alabama. His professional interests focus on the role of water-related processes in determining the nature and variability of atmospheric behavior on scales ranging from individual storms to climate. He holds M.S. and Ph.D. degrees in Atmospheric Science from Purdue University. As lead investigator on a joint EOS interdisciplinary investigation ("The Global Water Cycle: Extension Across the Earth Sciences") with Penn State, he researches climate model simulations of hydrologic anomalies, and the synthesis of a global moisture analysis. Additionally, Pete has studied the parameterization of convection and clouds in weather prediction models. He has chaired a panel which assists in developing a hydrometeorology project over the Mississippi Basin which will use satellite data to construct an interactive model of atmospheric and land/vegetation controls on the water balance of that region.

Camille Moody Jennings is the NASA Education Videoconference Producer and is series moderator for *On the Cutting Edge.* Camille earned a B.A. in math from the University of Texas at Austin and an M.A. in Education from UT San Antonio. Before obtaining secondary level teaching certification in math and physics, she marketed personal computers for IBM. Camille has taught high school math and physics in the classroom and for TI-IN Network. She has produced and moderated science programs for national distance-learning networks, including the NASA Langley atmospheric science series *Mission Earth Bound*–a New York Festivals medal-winner. Camille serves on the National Advisory Board of the NSF/NASA-sponsored Passport to Knowledge project and has moderated PBS electronic field trips for the project, including the *Live From Antarctica* series.

Lisa Ostendorf manages the education and external communication program for NASA's Office of Mission to Planet Earth (MTPE) at headquarters in Washington, DC. Her challenge is to communicate the excitement of NASA's Earth observation programs to the education community and to the public by coordinating successful outreach activities at each of the NASA field centers and supervising the development of print, video, and on-line MTPE materials. Prior to her current assignment, she worked for the Space Station Freedom Program Office. Lisa earned her undergraduate degree in business management at the University of Texas at Austin. She has been deeply involved in developing the Global Learning and Observations to Benefit the Environment (GLOBE) program. Lisa will co-moderate "The Whole World In Your Hands."

Dr. Jim Harris is the Program Manager for High Performance Computing in the Office of Mission to Planet Earth at NASA Headquarters. He earned a B.S. in Mathematics from Virginia State College; an M.S. in Applied Math from the College of William and Mary; and an M.S. in Administration (Information Technology) from George Washington University. Jim served Headquarters previously as the Program Manager for Scientific Computing in the Office of Space Science and Applications. He has also worked as the Assistant Head of the Computer Management Branch at Langley Research Center in Virginia . Jim's early experience included working as a mathematician and data analyst at Langley where he performed programming and design tasks, explored the early use of interactive environments, and performed capacity experiments and queuing analysis of processing systems in the central computer complex.

Dr. Fritz Hasler earned his Ph.D. in Meteorology from the University of Wisconsin and the University of Munich. He has worked at NASA's Goddard Space Flight Center in Maryland since 1974, after terms at NCAR and Laboratoire de Meteorologie Dynamique in Paris. His research involves estimation of winds and stereo height measurements using geosynchronous satellite imagery. Fritz is the manager of the Public Use of Remote Sensing Data (RSD) Program, GSFC Scientific Visualization in support of the White House GLOBE Project and the Interactive Image Spread Sheet Project. He has published over 40 scientific papers and is known for images and animations of hurricanes which have appeared frequently in the media. Recent TV and image appearances include an NBC Episode of *Sea Quest*, National Geographic *Nature on the Rampage,* and GEO Magazine.

Greg Cox is a Research Scientist for the University of Alabama in Huntsville (UAH) and serves as the K-12 Education Coordinator for the Institute for Global Change Research and Education at the new Global Hydrology and Climate Center (GHCC) in Huntsville, Alabama. He earned his bachelors and masters degrees in Biology (environmental focus) at the University of Alabama in Huntsville. Greg develops environmental education curriculum activities and coordinates teacher training within the GHCC, and is also the Director of Environmental Studies for the UAH Division of Continuing Education. He manages education and research contracts for numerous federal and state agencies and is assisting the Russian Ministry of Education in creating an environmental education network in the Rostov region of southern Russia. He serves as science advisor for ECO-BRIDGE, an environmental research and cultural exchange program between high school students in the Tennessee River valley and the Don River watershed in southern Russia, and has pioneered the use of packet radio as a means of reliable electronic communication between these groups.

Susan Sorlie is the DAAC User Services Specialist at NASA Langley Research Center in Virginia. She earned her undergraduate degree in Physical Geography from San Diego State University and her masters in Climatology from the University of Delaware. Sue then worked at the George Washington University Biostatistics Center as a research analyst programmer in the coordination of a national diabetes clinical trial. Upon joining NASA, she served as science support for the EOSDIS Goddard Distributed Active Archive Center (DAAC), where she updated and wrote descriptive catalogs of data sets archived there. Sue's current duties at the Langley DAAC include responding to user requests for data and information; facilitating the First ISCCP Regional Experiment (FIRE) data ingest process; serving as science support to researchers and data producers; and coordinating CD-ROM development, production, and distribution activities.

ECOlogic Corporation is a consulting and production company specializing in multimedia systems integration and application development. Their mission is to enable organizations to learn and develop for success. ECOlogic has established the Earth System Science Community Curriculum (ESSCC) Testbed, with support from Gonzaga College High School (Washington, D.C.), NASA, and NASA Science Internet, The ESSCC Testbed is a three-year project to train teachers and build a widely-distributed multimedia application delivered over the Internet using the World Wide Web. The ESSCC is designed to support teachers and students in their investigations of Earth system using NASA data and public domain software tools. The principals include:

> **Michael Keeler**–Principal Investigator, ECOlogic Corporation. He earned a B.S. in Development Economics from Georgetown University, School of Foreign Service; and an M.P.S. in Interactive Telecommunication from New York University where his areas of concentration included distributed network applications, human-network interface design, and digital video. He teaches Earth System Science at Gonzaga College High School. As Program Director, he is responsible for the overall management and oversight of the ESSCC Testbed.
>
> **Dr. Farzad Mahootian**–Co-Investigator, ECOlogic Corporation. He earned his M.S. Chemistry from Georgetown University, and his Ph.D in Philosophy from Fordham University. His research has encompassed a diverse range of topics from the role of metaphor in scientific concept-formation to experimentation with coupled chemical oscillators. Farzad has twelve years of teaching experience in philosophy at Fordham, Georgetown, and George Mason Universities. He teaches Earth System Science at Gonzaga. As the Science Education Director, Farzad leads teacher training and the development of Earth system science curriculum.
>
> **Greg Crist**–Executive Producer, ECOlogic Corporation. Greg earned a B.A. in English at Georgetown University. Prior to ECOlogic, Greg consulted in the areas of commercial information systems and software development. He now leads a team of programmers, systems integrators, and graphic designers to produce multimedia educational applications delivered via Internet and on CD-ROM. At Gonzaga, he has directed the graphic and technical production of Earth System Science Community Curriculum (ESSCC).

FILLING IN THE GAPS — Acquiring and Analyzing Satellite and Ground-Based Data

* Adapted from "A high performance Interactive Image Spread Sheet " (A.F. Hasler, K. Palaniappan, M. Manyin, and J. Dodge; *Computers in Physics*, Vol. 8, No. 3, May/Jun 1994; pp. 325-342) and "How When Affects What: Part 3–Local Temperature, Global Changes" *(Ground Truth Studies Teacher Handbook).*

Objective

Students will monitor daily rainfall to compute average daily rainfall and the estimate of total rainfall for the month. They will compare how their readings and computations are analogous to the methods used by researchers in computing similar data from satellite observations.

Background

The SSM/I satellite instrument receives passive microwave emissions from Earth to measure moisture levels worldwide. The instrument obtains data from ice, rainfall, oceans, clouds, and other sources of moisture in and below the atmosphere. On any given day, the geometrical position of the satellite instrument relative to Earth permits it to record data from most–but not all –of the planet's surface. This is because the satellite instruments cannot "see" all points simultaneously. Consequently, the moisture image for both hemispheres reveals patterns of diamond-shaped blackout patches from which no data has been recorded. Throughout a month-long observational window, however, all surface points eventually come into view, so that moisture readings can be captured for the entire Earth. Therefore, moisture data for a given point may be recorded for 25 out of 31 days, but for another point of data may be recorded for all 31 days. Inestimating total rainfall for the month for all points on Earth, the computation may be based on a limited set of daily readings. When a daily reading is not made for a given point, this "gap" in the data must be accounted for mathematically in the computation. To explore how scientists "fill in the gaps" for missing data from instruments such as SSM/I, students will monitor and record daily rainfall measurements for most–but not all–days in a one month observational window.

Materials

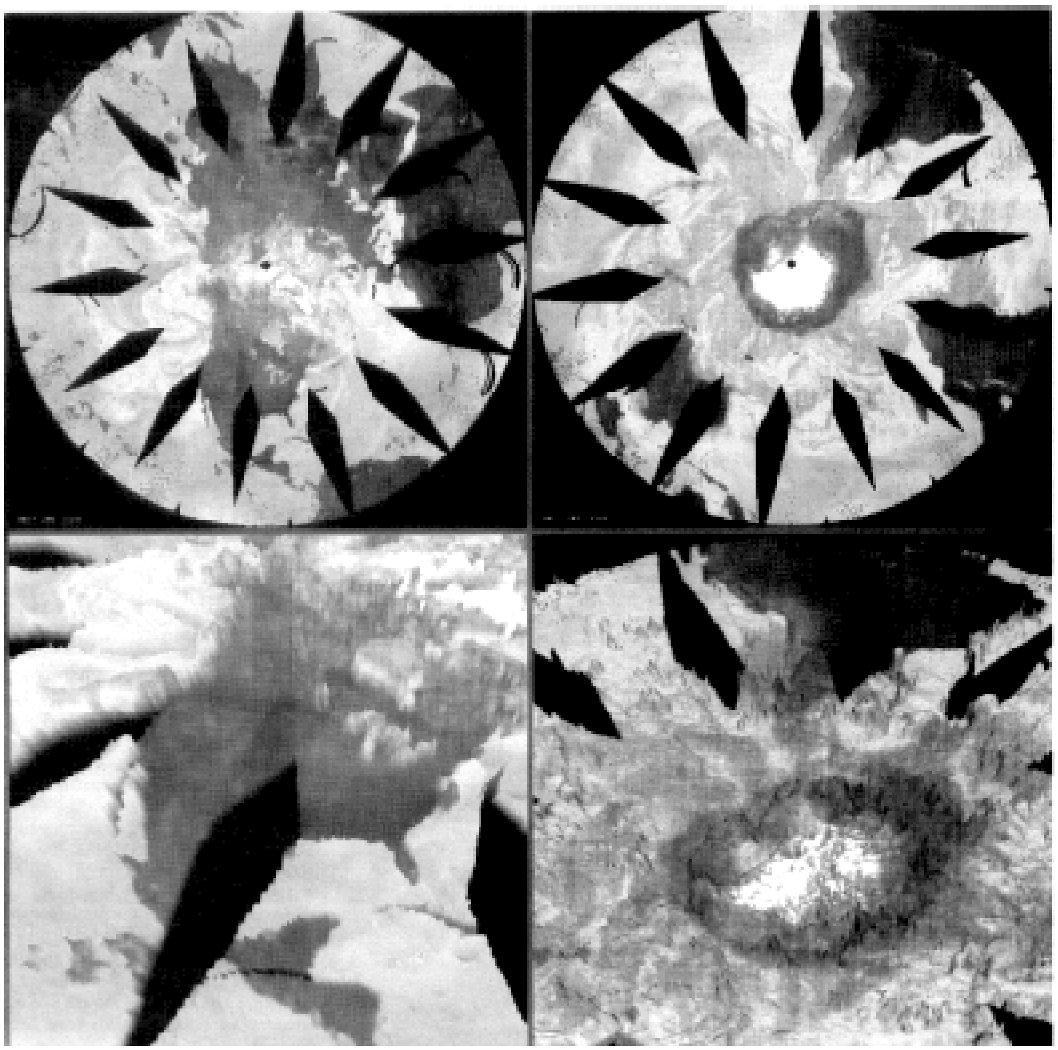
1 rain gauge per student   pencil   paper   calculator

Procedure

1. Have each student set up a rain gauge at home. Students should record daily rainfall for a one month period. For a given gauge, each measurement must be made at the same time of day, although it is NOT imperative that a reading be made every day of the month. Empty the gauge after each reading, and empty the gauge even on days for which NO reading is made.
2. Each student should compute his or her *average daily rainfall* measurements by adding together the daily readings and dividing by the number of measurements taken.
3. Compare the average daily rainfall computed by each student for the entire class.
4. Each student should multiply his or her average daily rainfall by the number of days in the month to compute the *estimate of total rainfall for the month.* The execution of this step is essentially "filling in the gaps" for days in which no data was available.

Questions

1. How might the method used for measuring rain in the gauge introduce error into the readings? How might varying the time each day the reading is taken introduce error?
2. How might failing to measure rainfall on a very rainy day affect the computation of the average daily rainfall?
3. Assuming that most students live in relatively close proximity to one another, and have essentially "measured the same rain," propose reasons why average daily rainfall computations may differ from student to student.
4. Why is it acceptable to "fill in the gaps" when computing the estimate of total rainfall for the month when a measure is not made each and every day? How can you decide on the level of acceptability?



SODA BOTTLE HYDROLOGY

*From "Try Out Soda Bottle Hydrology" by the Hazardous Waste Remedial Action program, U.S. Department of Energy, 1994

Objective

Students will explore hydrology by using a soda bottle to create a model hydrologic cycle.

Background

Hydrology is the study of water. The *hydrologic cycle* is the endless recycling process water goes through on Earth. Heat from the sun make water evaporate. The water vapor rises into the atmosphere, where it cools and condenses forming clouds. The clouds release water through precipitation (rain sleet, snow, etc.). The water falls onto the ground and into the ocean. Some of it is absorbed into the ground into regions called aquifers, which are porous rock structures that hold water (sometimes for thousands of years.) Some of the water runs along the surface to the ocean. Then the water starts to heat up again and the cycle repeats. How long it takes water that falls from the clouds to return to the atmosphere varies greatly. Scientists predict it would take nine days to replace all of the atmospheric water and 37,000 years to replace all of the water in the ocean.

We tend to take the abundance and purity of our water for granted, but we should not do this. There is not an endless source of fresh water, and some scientists fear we could run out of it someday. Pollution and contamination of both surface and groundwater reduce the amount of clean, fresh water available. Common pollution sources include: chemical fertilizers, pesticides, waste discharge, leachate from toxic waste dumps, accidents, leaking underground gasoline/fuel storage tanks, and illegal dumping.

Since Americans use an average of 325 liters or about 85 gallons of water a day, it is very important to understand where our water comes from and how it gets there.

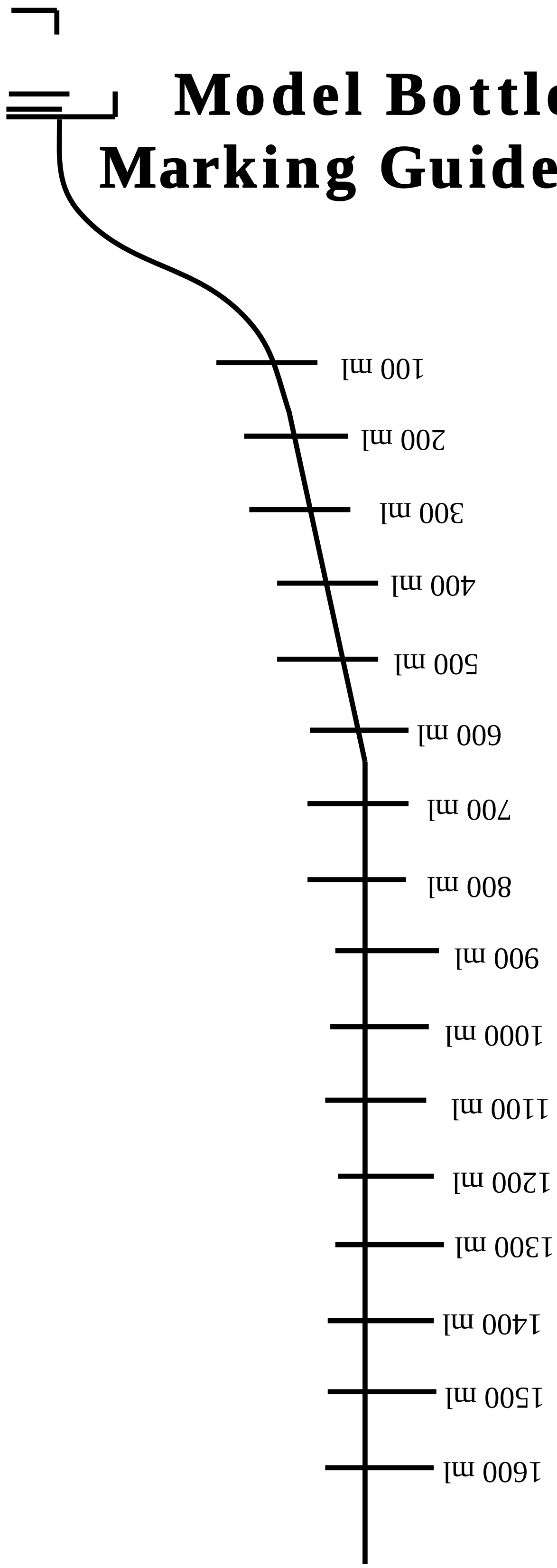
Materials

ring stand	water	ice
clear plastic two-liter soda bottle	permanent marker pen	rubber band
scissors	1 metric ruler	nylon screen (10 cm X 10 cm)
sand, dirt, small rocks, or cat litter		

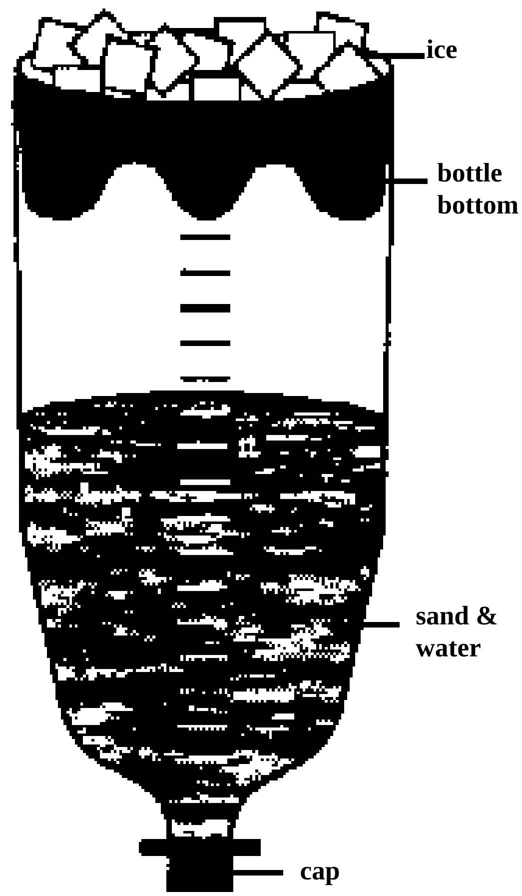
Procedure

1. Remove the label from the bottle.
2. Create the model bottle by cutting off the bottom 5 cm of the bottle. Save this bottle bottom.
3. Cut out the marking guide on the following page. Place the cut out marking guide against the bottle, and using a permanent marker pen, label the bottle with the volumes on the marking guides.
4. Wad up the nylon screen and insert it into the neck of the model bottle. Recap the bottle.
5. Fill your model bottle with sand to the 1,000 ml mark.
6. Holding the bottle by hand, slowly pour in 200 ml of water. Let the water settle.
7. Turn the cut out bottle bottom upside down and insert it into the top of the model bottle, so you can add material to the bottle bottom.
8. Put some crushed ice into the bottle bottom (which is at the top of the model bottle).
9. Set the bottle in a ring stand in sunlight or beside a strong lamp and observe.
10. Based on your observations and the descriptions above, label the groundwater model bottle with the following: *Groundwater* *Surface water* *Evaporation* *Condensation* *Precipitation*

Model Bottle Marking Guides



Assembled Model



Bottle

HOW WHEN AFFECTS WHAT — Part 1 When You Look, Where you Look

* From Aspen Global Change Institute 1992 - Ground Truth Studies

Objective

Students will gather and record visual and written data from their surroundings, and show how the time of data collection, or the sampling window, can affect an outcome, sometimes resulting in false conclusion.

Background

In global change research, as in any scientific research, the timing and duration of data collection, and the window of the data set are of critical importance in reaching accurate conclusions This is best illustrated by seeing how "truth" can easily be distorted by isolating a part of the complete data set or by collecting data at a particular time. Issues such as natural variability often come into play, and it is important to evaluate cause and effect, effect and cause.

In this activity, students will photograph and/or count the number of people in the public areas of the school such as the cafeteria or gym. They will also consider various "windows" of time within which to examine data. They will discuss what conclusions might be drawn from their data seta and why these conclusions might not be accurate. In part two of this exercise, students will then examine global change data, a graph of global temperatures, and extend their understanding of how time of data collection and the window of the data set affects conclusions. It may also be suggested to the students that they measure and compare daily temperatures instead.

Materials

Camera and film (preferably instant developing film or a video camera for instant results)
paper
graph paper
pencils & pens

Procedure

1. Have students choose a public area of the school as their subject of study. They should image (count or photograph the people in) these areas from above (from a window, high up in a nearby building) at various times of day, say 8 am, and lunchtime, and on different days of the week, and count the students that appear at each time. They can choose some special times to collect data.
2. The students should then graph their data and describe what they have learned about the phenomenon they measured — such as average number of students counted, based on when the observations were made.

Questions

Ask your students to examine their data and pose questions that can be answered by evaluating the data. How would someone interpret the data if they did not know where and when it had been collected? What kinds of conclusions can be drawn from the information collected? How did the time of collection affect the answers to the question posed? How did the window selected affect the outcomes? How might the data be interpreted or misinterpreted? Students can come up with conclusion they know are false, but which can be supported by their data sets. Have your students discuss ways in which information might be unintentionally misread or intentionally manipulated.

Extension

1. Ask the students to design a sampling schedule which would help avoid gross distortions of reality, but which do not require continuous sampling.
2. Have students bring in examples from articles in the press which demonstrate the effect of how and when data is collected has an impact on the conclusions drawn.

HOW WHEN AFFECTS WHAT — Part 2 Is it Getting Hot or Not?

* From Aspen Global Change Institute 1992 - Ground Truth Studies

Objective
Students will critically interpret graphical data, and evaluate the difficulties inherent in interpreting and forecasting long and short term trends.

Background
During the past 20 years, much attention has been given to the potential climatic effects of increasing concentrations of atmospheric greenhouse gases. The graphs of ground-based temperature measurements on the following pages show that there was little trend toward increasing or decreasing temperature during the 19th century, a marked increase of about 0.5° from 1910 to 1940, followed by a period of erratic and dramatic temperature fluctuations from 1940 to 1970, and then followed by a sharp increase in temperature to the present. All six of the warmest years in the global record have occurred since 1980. Some scientists see a trend of increasing global temperature in this data. Others emphasize the large amount of variability in the global temperature record, arguing that Earth has not warmed as much as predicted by climate modelers, thereby implying no evidence of global warming. Against this backdrop of controversial trends, government policy makers must consider whether they need to take action to reduce greenhouse gas emissions or not. Some policy makers oppose any specific timetables for combating global "warming," citing lack of agreement among scientists on the problem. Others wish to establish specific targets of cutting the pollution that causes greenhouse gases (i.e. carbon dioxide, etc.). This exercise encourages students to examine the process and draw their own conclusions by analyzing the actual data which is the basis of the controversy. They will extend the understanding gained in Part 1 of this activity to global mean temperature change, observing how the sample or window they choose effects the outcome of their study. The data presented here was compiled by P.D. Jones, T.M.L. Wigley and P.B. Wright from the Climatic Research Unit of the University of East Anglica in England.

Materials
Four graphs of global mean temperature, each representing the difference between the actual measurements for the years indicated and the average for 1951-80; the first from 1882 to 1894; the second from 1944 to 1956; the third from 1978 to 1990; and the fourth from 1854 to 1990.

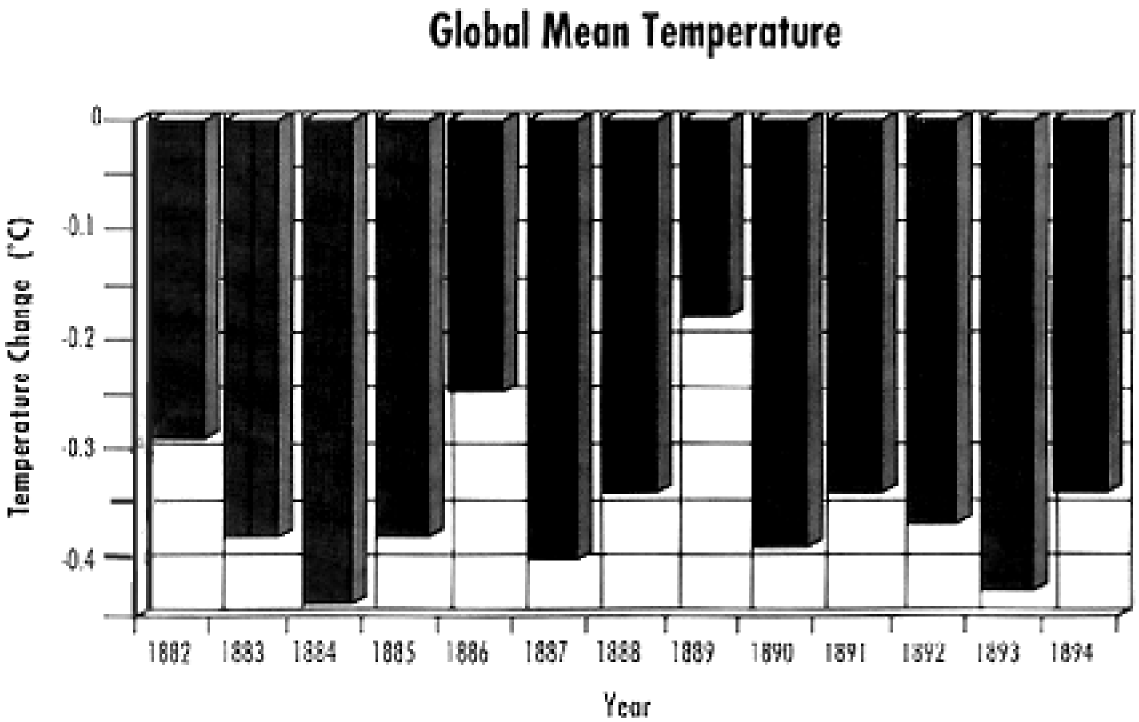
Procedure
1. Divide the class into four groups and give each group one of the four global mean temperature graphs. The groups cannot share data. Students will study their sample of temperatures and observe how readings fluctuate from year to year. From their samples, they should theorize and support whether there is evidence that global temperature was rising, falling, or remaining constant.
2. After the students have spent some time studying their graphs, ask them to project what global surface temperature will be 10, 20, and 50 years into the future.
3. Have each group present their predictions for 10, 20, and 50 years in the future.
4. Let the students from the first three groups compare their estimates with the longest term graph.

Discussion
1. Compare the four sets of predictions and consider the reliability of each. Discuss the implications of basing conclusions on limited data and the patterns that could be inferred from considering each of these subsets. The pitfalls of basing conclusions on limited data sets should become obvious.

2. How much data is needed to make reliable predictions? Have students develop a list of things they would need to find out in order to prove that their projections were valid.

HOW WHEN AFFECTS WHAT — Part 2 Is it Getting Hot or Not?

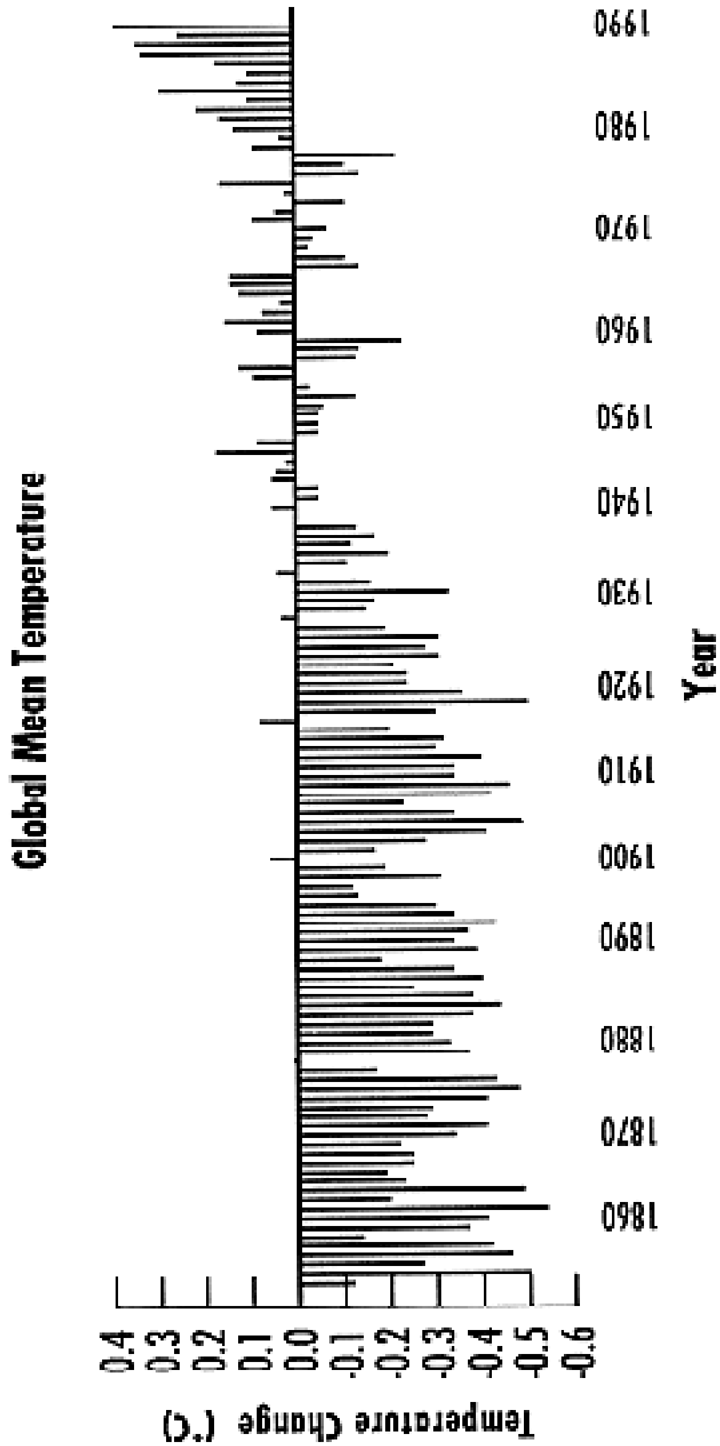
* From Aspen Global Change Institute 1992 - Ground Truth Studies



* Global-mean combined land-air and sea-surface temperatures, 1861-1989, relative to the average for 1951-1980.

HOW WHEN AFFECTS WHAT — Part 2   Is it Getting Hot or Not?

* From Aspen Global Change Institute 1992 - Ground Truth Studies



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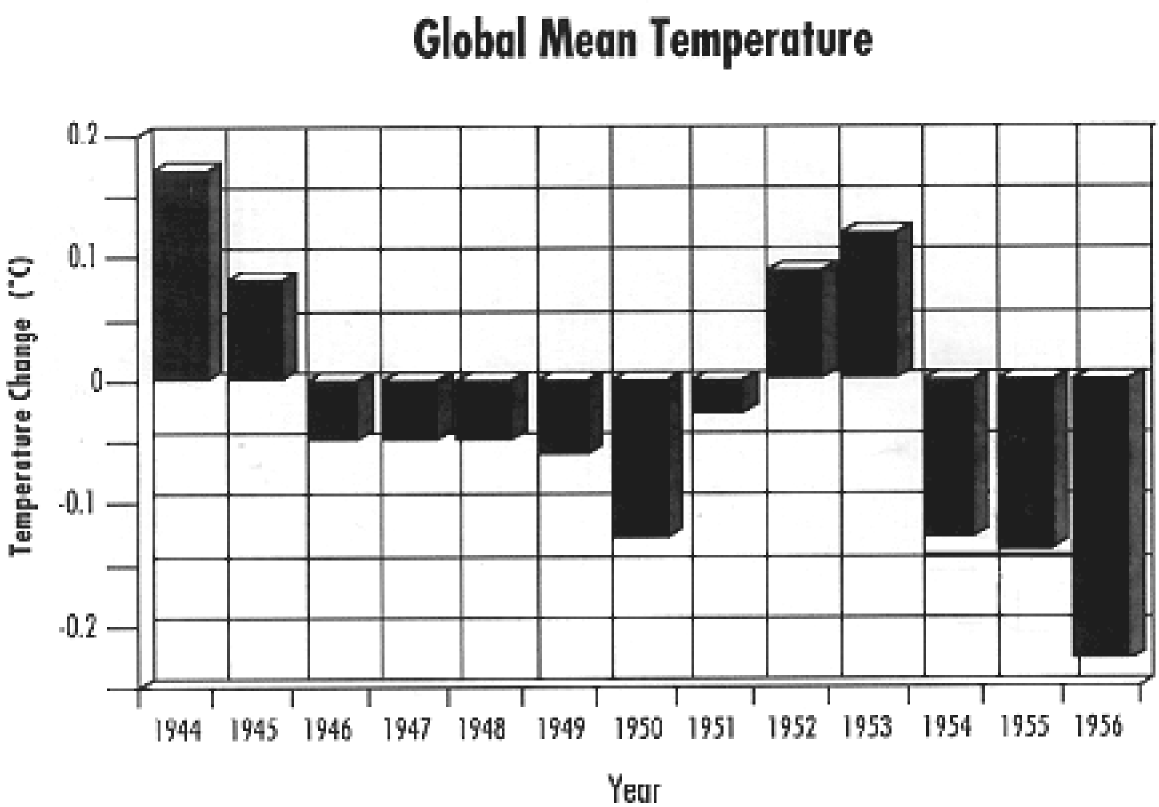

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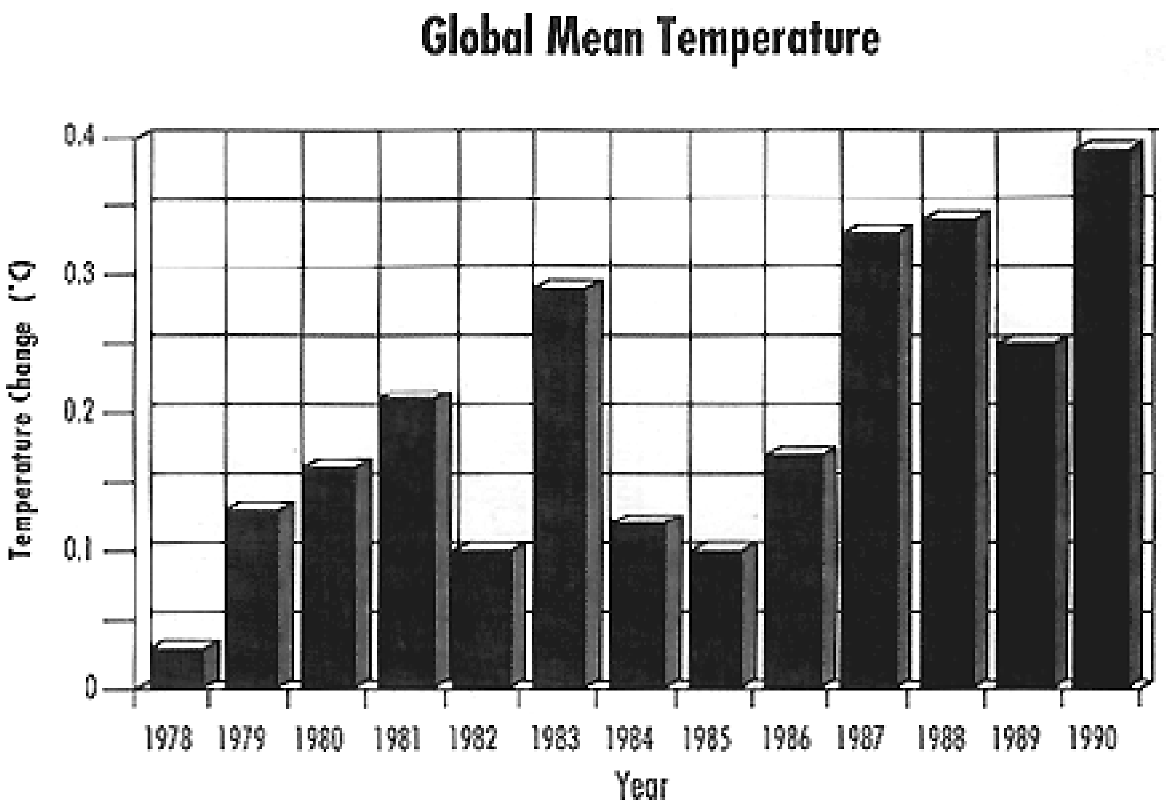

* Global-mean combined land-air and sea-surface temperatures, 1861-1989, relative to the average for 1951-1980.

COVER MAPPING LAND

*** From Aspen Global Change Institute 1992–Ground Truth Studies**

Objective

Students will recognize and explain the differences between satellite images and topographic maps; identify different land cover types on satellite images and relate them to the corresponding areas on the topographic maps; and explain the relationship between cover types, water flow, and water quality.

Background

Land cover, in remote sensing, refers to the primary reflective or emitting surface detected by sensors. Land cover differs from forest or vegetative cover in that it is all inclusive of everything detected by the sensors: Trees, fields, houses, lawns, lakes, roads and parking lots, etc. Land cover significantly influences water flow and water quality. Because vegetation intercepts precipitation with its many surfaces, it slows and decreases runoff–the flow of water across the land surface. Runoff is faster and greater on bare ground or paved surfaces. Vegetation cover permits more infiltration, or soaking of precipitation into the ground, because root channels keep the soil loose and decaying organic material acts as a sponge. Impermeable paved surfaces do not allow infiltration for recharge of the soil moisture and groundwater reserves.

Because land cover influences water flow across a watershed, it directly impacts water quality in the watercourse. If vegetation is removed, precipitation hits the soil surface more energetically and runs off more quickly, carrying with it greater amounts of soil and plant nutrients. This results in increased erosion, watercourse turbidity, and decreased water quality. Eventually, the suspended soil particles settle to the bottom of the watercourse as sediment, perhaps suffocating riverbed organisms or filling in reservoirs behind dams. On the other hand, sediments may settle during receding seasonal floods renewing the fertility of riverside agricultural fields. Runoff may enter a watercourse at a different temperature than the water already there. A temperature change may benefit some organisms living in the water while making it less suitable for others. For example, trout require cold water, but catfish prefer warmer water. Runoff may bring bacteria, pesticides, or toxic chemicals from the land into watercourses, thus decreasing water quality. Mining, road construction, housing developments, industrial expansion, and the conversion of forests to crop land all decrease the amount of vegetative land cover. Reforestation, mine reclamation, residential landscaping laws, soil conservation ordinances, the creation of parklands, and the cultivation of perennial instead of annual crops all increase vegetative land cover. Converting land cover near a watercourse can directly affect water quality. Removing trees shading a watercourse will increase water temperature, while planting trees will decrease water temperature, wind speed, and evaporation.

In this activity, students will use remotely sensed images and topographic maps to classify land cover types in their watershed. A field trip to specific sites will allow the students to "ground truth" cover types found on the remotely sensed images and infer that information to other sites not visited. The purpose of this activity is to teach students how information gained from a small sample of sites can be used to interpret remotely sensed images and to make educated guesses as to the extent of similar types of land cover within their watershed.

Maps are generalizations of reality, often containing numerical or alphabetical information, as well as selected and adjusted graphical detail. Within limits, different objects, such as areas of different land cover, can be distinguished on remotely sensed images because they each have a unique spectral signature. That is, each type of vegetation or material covering the land reflects or emits a unique radiation pattern that is sensed and recorded. To a certain degree, then, it is possible to differentiate between different types of land cover, thus corn fields, pine forests, open water and concrete building may all appear differently on remotely sense images. There are limitations to what can be interpreted from any remotely sensed image, however. While it will almost always be possible to tell a paved parking lot from an agricultural field, it may be difficult to determine whether a field contains corn, barley,or wheat, or to distinguish a marsh from a rice field without more information than one satellite photo contains.

COVER MAPPING LAND ***Continued***

Materials

Topographic maps and aerial or satellite images of your watershed that have been laminated
grease pencils rulers

Procedure

1. Ask students to locate their watershed on both their map and satellite image.
2. Introduce the concept of spectral reflectance. Each type of vegetation or material covering the land reflects or emits a unique electromagnetic signature, thus being recorded by the satellite sensor as unique and appearing as a uniquely colored entity on the satellite image. With a grease pencil on the laminated satellite image, outline ten areas in your watershed that appear distinctly different on the image and thus indicate different land covers.
3. On the basis of their knowledge of the area, your students should record what might be the ground cover on each of several areas which are close enough to the school for a field trip to test their accuracy.
4. Take your students on a field trip to a few of the representative sites. Bring along the maps, images, and outlines as you visit the various parts of the watershed. Your students should record the cover in each of the areas that they outlined. Have them compare their predictions of land cover to what is actually there.
5. Back in the classroom, have your students reconsider the accuracy of their predictions on the basis of the evidence from their ground truthing.

Questions

Organize a discussion with your students by asking the following questions:

1. What vegetation symbols appear on the map and how do they compare with the remotely sensed images?
2. Which is older, the map or the satellite image? Other than the date printed on the map and image, what indicates that one is older than the other?
3. How does the appearance of towns and cities differ between the map and satellite image?
4. If the contour lines on the map were erased, what clues would you have about the location of high land? The remotely sensed image has no contour lines, can the students find clues as to the outline of the watershed?
5. What indicates that the deeper and more fertile soils are on the low or the high land?
6. How would your students describe the texture of the different cover classes that you see on the satellite image?
7. What percentage of the local watershed is covered by forest, grasslands, agriculture, human settlements, etc.?

Evaluation

1. Describe several ways in which satellite images are different from topographic maps.
2. Locate and name all the land cover types you can find on the satellite image.
3. Locate and name all the land cover types you can find on the topographic map.
4. Explain how different types of land cover affect runoff and infiltration.
5. Describe several human activities that change land cover and thereby decrease water quality. Explain the impacts.
6. Suggest some possible changes in land cover that humans could make in the watershed to increase water quality.

ACCESSING AN EOSDIS DAAC

Objective
Educators and students will learn how to access and use data from an EOSDIS (Earth Observing System Data and Information System) DAAC (Distributed Active Archive Center).

Background
The EOSDIS receives, processes, stores, and distributes large amounts of data about the Earth system. EOSDIS offers easy access of this information to classrooms, allowing teachers and students to conduct research, develop models, and make assessments. EOSDIS data is warehoused at computer facilities called DAACs (Distributed Active Archive Centers) where users can ask scientific questions about the data using specialized software tools. These tools help locate and access data in key areas of concern such as water and energy cycles; oceans; chemistry of the troposphere and lower stratosphere; land surface hydrology and ecosystem processes; glaciers and polar ices sheets; the chemistry of the middle and upper stratosphere; and solid Earth. Scientists at the DAACs generate data products, taking raw data from a satellite instrument and performing investigations until the data become useful to the user. Both raw and value-added data sets from satellites and conventional sources are available to individuals accessing a DAAC. The capabilities provided by EOSDIS, will foster interdisciplinary research, support the training and educating of the next generation of Earth scientists, and expand our understanding of our planet and global change. This excursion explores how to access a DAAC, specifically Langley Research Center DAAC in Hampton, Virginia. For Earth system data maintained at other DAAC sites, consult the *EOSDIS Fact Sheet* included in this packet.

Materials
computer   modem   telephone hook-up   Internet access

Procedure
The Langley DAAC is responsible for archiving and distributing NASA science data in the areas of radiation budget, clouds, aerosols, and tropospheric chemistry. The DAAC allows users to logon, search the data inventory, choose the desired data sets, and place an order. Data may be received either electronically (via FTP) or on media such as 4 mm tape, 8 mm tape, or CD-ROM.

1. Users <u>with an X-Windows terminal</u> (e.g. Motif) or a Sun Open Windows display system with access to Internet, may log onto the system by entering:

   xhost + eosdis.larc.nasa.gov (or: xhost + 192.107.191.17)
   telnet eosdis.larc.nasa.gov

login name: ims
password: larcims

   At the prompts, enter x for the X-Windows interface, then your display name (name of your workstation followed by ":0" or internet address followed by ":0").

2. Users <u>with access to NCSA Mosaic</u> can use the following URL address: http://eosdis.larc.nasa.gov

3. Users <u>without X-windows</u> but with Internet access may log on by entering:

   telnet eosdis.larc.nasa.gov

login name: ims
password: larcims

   At the prompt, enter c for the character interface and then press return.

4. Users <u>who cannot access the system</u> or who have any questions may contact: Langley DAAC User and Data Services; NASA Langley Research Center; Mail Stop 157B; Hampton, VA 23681-0001.
   Phone: (804) 864-865   FAX: (804) 864-8807   email: user@eosdis.larc.nasa.gov