



Exploring Earth from Space

With International Space Station (ISS) EarthKAM Photography

Lithograph Set and Instructional Materials

Students participating in NASA's **ISS EarthKAM** (International Space Station **E**arth **K**nowledge **A**cquired by **M**iddle School Students) program have taken thousands of photographs of Earth from space. Photographs taken by the ISS EarthKAM program offer a compelling, inquiry-based avenue for students and teachers to explore and better understand Earth.

This guide suggests a variety of ways in which ISS EarthKAM photographs can be integrated into inquiry-based learning activities that enhance the learning and teaching of science, geography, mathematics, and technology.

This *Exploring Earth from Space* lithograph set includes the following:

- Educator's guide with student information sheet and worksheet
- 14 lithographs:

ISS EarthKAM Photography

Earth Features Seen from Space

Andalusia, Spain

Buenos Aires, Argentina

Cloud Patterns

Colorado River

Creative Agriculture in Response to Limited Water

Ganges River Delta

Gazankulu Homeland, South Africa

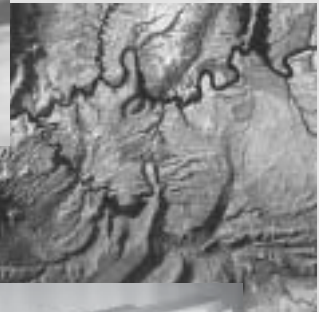
Nile River Delta

Northeast Coast of Australia

Río Salado, Argentina

San Jose, California

Tibetan Plateau



Introduction

NASA's ISS EarthKAM program offers a unique opportunity for students across the United States and around the world to take images of Earth from space. Using the tools of modern technology—including the Internet and a digital camera mounted on the International Space Station (ISS)—EarthKAM students are able to take stunning, high-quality photographs of our planet. This lithograph set includes a sampling of these ISS EarthKAM images.

This guide provides suggestions for introducing space-based photographs of Earth to students, shows how to identify and analyze key features within these lithograph images, and outlines a variety of activities that can be integrated into the teaching of science, geography, mathematics, and technology.

Understanding ISS EarthKAM Photography

More information about how the images are taken is available on the *ISS EarthKAM Camera* lithograph. Many more images, as well as education support materials and information describing how to participate in the ISS EarthKAM program, are available on the Web at <http://www.earthkam.ucsd.edu>

Familiarizing Yourself with ISS EarthKAM Lithographs

We recommend that you spend time examining the lithographs—identifying features, locating them on maps, asking questions, and so on—before introducing them to your class. The *Earth Features Seen from Space* lithograph and the student sheets are helpful guides. Visit the Educators section of the ISS EarthKAM Web site (www.earthkam.ucsd.edu) for additional support in exploring the images, including answers to the questions posed on the back of each lithograph.



Introducing ISS EarthKAM Lithographs to Students

When presenting the lithographs to students, explain that they are visible-light photographs taken from the ISS or the Space Shuttle. Emphasize that the photographs were taken by students just like themselves who have participated in the ISS EarthKAM program.

Explore a Photograph

Have students explore a lithograph in detail. The *Exploring Earth from Space* worksheet, located at the end of this guide, offers a series of questions that will help students discover information from the image. To foster an open-ended, inquiry-style experience, tell students *not* to read the back of the lithographs until you direct them. This approach fosters student creativity and improves critical observation skills. Encourage students to use atlases and other reference materials to enhance their exploration of the photograph.

Brainstorm Questions

As students work with the lithographs, prompt them to write down questions and ideas generated as a result of their exploration. Working with Earth photographs involves asking questions about a) what is there, b) why it is there, c) how did it get there, d) what effects it has, and e) what this suggests about an area or topic. These questions often serve as the basis for further study of other images. This brainstorming is most successful if done as a class or group discussion.

Integrating ISS EarthKAM Lithographs into Your Curriculum

Earth photographs can spark student interest, be sources of questions and information, serve as starting points for inquiry-based studies of Earth, and be used in student assessment. Many topics for study are possible with these lithographs, as well as with the thousands of images available through the ISS EarthKAM Web site located at <http://www.earthkam.ucsd.edu>. Outlined below are ideas for using ISS EarthKAM imagery to enhance your curriculum.

Map Skills and Geographic Analysis

Students can use the latitude and longitude coordinates provided with each image to determine the image's location on a world atlas. They can match the features in the photographs to the same features in atlases. Students can create a classroom bulletin board by mounting the lithographs around a world map and then using string to connect each lithograph to the corresponding location(s) on the map. What parts of the world are shown in the photographs? What human and physical characteristics can be identified from maps of the photographed regions? What types of information do images of Earth provide that maps do not?

Land Use and Agriculture

Images of Earth from space show how agriculture shapes Earth's surface. *Río Salado*, *Creative Agriculture*, *Buenos Aires*, *Northeast Coast of Australia*, and *Nile River Delta* show different types and patterns of agriculture. Students can consider both the importance and the impact of agriculture. They can look at the relationships



among agricultural lands, natural vegetation, water sources, and cities. Where does agriculture occur? Why is it located in some areas, but not others? What are the patterns and shapes of agriculture? What factors cause these observed patterns and shapes? How does agricultural development affect natural ecosystems?

Land Use and Conservation

Human use of the environment, as well as efforts to protect and conserve environments from human influence, can be seen in the lithographs. *Gazankulu Homeland*, *Ganges River Delta*, and *Andalusia, Spain* all show side-by-side areas of settlement and conservation. This type of visual information gives students a context for studying conservation issues and human geography. How do the protected lands appear different from the unprotected lands? What are the borders between them like? What types of land are protected? Why are these lands protected? For what are the nonprotected lands used?

Cultures

Earth photographs can be used as an entry point into the study of regional culture and history. *Gazankulu Homeland* shows a visual contrast between rural settlements and a national park. What were the social and political factors that led to this settlement pattern? How are these factors different today? Urban areas are a reflection of the cultures that build them. Close study of *Buenos Aires* shows a city with docks, streets, airports, parks, and racetracks. What do the people of Buenos Aires do for work and for recreation?

Rivers

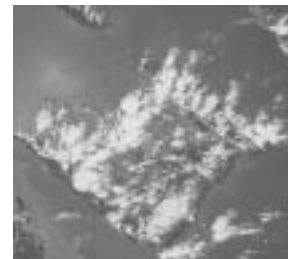
Rivers, vital parts of the water cycle and major shapers of Earth's surface, are particularly visible when viewed from space. Students can observe variations in river form, how rivers are a cause and a reflection of a given area's landscape, and how humans use and affect rivers; they can also compare different types of drainage systems. They can compare the deltas in *Ganges River Delta*, *Buenos Aires*, and *Nile River Delta*. Prominent rivers are visible in *Río Salado*, *Creative Agriculture*, *Andalusia, Spain*, and *Colorado River*. What do rivers look like and why? What colors are rivers in the lithographs and why are there differences? Why do some rivers meander, while others follow a more direct path?

Geologic Features and Processes

Many types of geologic features and processes can be observed from the perspective of space. The San Andreas Fault slices a straight line across the *San Jose* lithograph. What do fault lines look like? Volcanism, folding, and differential erosion are visible in *Colorado River*. Students can sometimes identify sedimentary and igneous rock formations in the lithographs. They can compare sedimentary landforms in *Colorado River* to igneous or metamorphic landforms in *Northeast Coast of Australia* or *San Jose*. How do sedimentary rocks appear to erode compared to igneous rocks? How are volcanic mountains shaped compared to other types of mountains?

Atmospheric Processes

One factor influencing weather is the difference in the heat-holding capacities of land and water. Students can observe the location of clouds in relation to land masses and water in *Cloud Patterns*, and they can develop explanations for their observations. Students can also download current images of clouds from weather sites on the Web to expand their study of weather patterns and phenomena.



Change over Time and Space

Photographs of Earth taken from space offer compelling visual information that can be used to study changes over time. By comparing photographs of the same area taken at different times, students can analyze such things as seasonal and human-caused changes. *Tibetan Plateau* shows images taken 10 months apart. What has changed between these two images? Are these changes surprising? What features have changed? Students can use Web resources to find additional images of the areas shown in these lithographs to observe change over longer periods of time. How do rivers change on a seasonal basis? How much have cities or agricultural regions grown or shrunk over time?

Mathematics

The ISS EarthKAM lithographs offer practical, real-life opportunities for students to learn many math skills, including measurement, proportionality, scale, and graphing. Students can use the dimensions of the photographs to create a scale bar and measure the size of objects. How long is the dam and how large are the agricultural fields in the *Río Salado* lithograph? What is the area of the Nile River Delta? What is the average population density of Buenos Aires? The back of the Buenos Aires lithograph states that the city is home to about 13 million people, and students can estimate the size of the city from the photograph. What is the scale of the photograph? How does this scale compare to the scale of an atlas? How large are various features? What is the relative size of different features?

Supplemental Resources

ISS EarthKAM images are only one of many available types of Earth imagery. This guide and the *Exploring Earth from Space Worksheet* can be used with images and remotely sensed data of Earth taken from space by other instruments. These sources of information can help you find additional images and resources for use in your classroom. Also check your local library, the Web, and your NASA Educator Resource Center.

Books

- Earth from Space:** An excellent introduction to studying Earth using various types of images. Text by Dr. Amy Leventer and Dr. Geoffrey Seltzer, National Audubon Society Pocket Guide, Alfred A. Knopf, 1995. ISBN 0679760571.
- Looking at Earth:** Topographical portrait of Earth, organized by region, including stunning visual photographs collected by spacecraft and remote-sensing equipment. Priscilla Strain and Frederick Engle, National Air and Space Museum Smithsonian Institution and Turner Pub. ISBN 1878685163. (Out of print.)
- Mission: Earth, Voyage to the Home Planet:** A first-hand account of an astronaut's journey on the Space Shuttle *Endeavour* recounts his mission to study the health of the planet. Thomas D. Jones and June A. English, Scholastic Press, 1996. ISBN 0590485717.
- National Geographic Satellite Atlas of the World:** In this unique atlas, remotely sensed photographs (of all types), maps, and information are interconnected and organized by geographic region. National Geographic Society, 1998. ISBN 0792272161.
- Orbit: NASA Astronauts Photograph the Earth:** High quality photographs taken by Shuttle astronauts. J. Apt, M. Helfert, J. Wilkinson, R. Ressmeyer, National Geographic Society, 1996. ISBN 0792237145.
- Seeing Earth from Space:** This book begins with photographs of Earth taken from the Moon and then moves on to photographs taken by astronauts orbiting the planet. Patricia Lauber, Orchard Books, 1990. ISBN 0531059022.
- The Third Planet:** Astronaut Sally Ride looks back at Earth, showing what the view reveals about our planet's environment and humanity's impact on it. Sally Ride and Tam O'Shaughnessy, Crown Publishers, 1994. ISBN 0517593610.

Web Sites

- EarthRISE:** Photographs of Earth taken by Shuttle astronauts. They can be searched by key word (Form) and by map (Political and Topographical). <http://earthrise.space.com/>
- Johnson Space Center Earth from Space:** Many of the best astronaut-acquired photographs of Earth. Photographs can be searched easily by areas of interest: cities, weather, features, technical, and others. <http://earth.jsc.nasa.gov>
- ISS EarthKAM:** ISS EarthKAM photographs, including those in this lithograph set, as well as educator guides, activities, and other classroom materials are available at this Web site. Go to the Datasystem to search the photographs. <http://www.earthkam.ucsd.edu>
- Mission Geography:** Curriculum materials that link the content, skills, and perspectives of *Geography for Life: The National Geography Standards* with the missions, research, and science of NASA. <http://missiongeography.org/>
- NASA Education Home Page:** Gateway to information regarding educational programs and services offered by NASA for educators and students across the United States. <http://education.nasa.gov/>
- NASA Office of Earth Science:** NASA site focusing on our home planet. Details on current events in Earth science, NASA Earth science missions, Earth images, and educator resources. <http://www.earth.nasa.gov>
- NASA Office of Space Flight:** Information on the Space Shuttle, International Space Station, Mir Space Station, rocket launches, and other programs that are exploring, using, and enabling the development of space. <http://www.hq.nasa.gov/osf/>
- NASA Spacelink:** Specifically for the educational community, Spacelink provides links to virtually every one of NASA's Web sites and resources, including programs, educator materials and opportunities, and current events. <http://spacelink.nasa.gov>
- Terraserver:** Terraserver has a collection of very high-resolution aerial photographs and satellite images. You can order prints of individual images. Search by name, map, or latitude and longitude coordinates. <http://www.terraserver.com>

Exploring Earth from Space

Student Information Sheet

Students who participated in NASA's **ISS EarthKAM** (International **S**pace **S**tation **E**arth **K**nowledge **A**cquired by **M**iddle School Students) program have taken thousands of photographs of Earth from space. Using the tools of modern technology—including the Internet and a digital camera mounted on the International Space Station—EarthKAM students are able to take stunning, high-quality photographs of our planet.

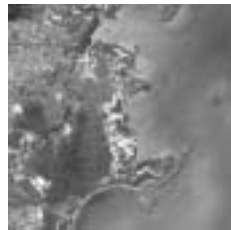
You will be closely studying ISS EarthKAM photographs that were taken from either the International Space Station or the Space Shuttle. Before beginning your exploration of these photographs, you need to learn a few facts about photographs from space so that you can better understand what you see.

Earth Features

You can identify human and physical features by examining their appearance in the photographs and comparing them to maps of the same area. In addition, many features are identified in the labeled image located on the back of each lithograph. The *Earth Features Seen from Space* lithograph identifies features like those shown below. Use it as an identification guide as you study other photographs of Earth from space.



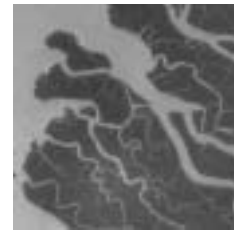
agriculture



beaches



urban areas



delta

Colors

The photographs you will be exploring are all visible-light images—they show what your eyes can naturally see. However, the processing and printing of the photographs has changed the colors slightly; they appear somewhat redder than they should.

Colors on the Photograph:

blues

black, dark blue, or dark green

white

red, orange, peach, or brown

Can Indicate:

water

vegetation

clouds, snow, or human impacts

ground, soil, or sediment

Image Identification Number

Each ISS EarthKAM photograph has its own image identification number. These numbers contain information about how and when the photograph was taken. The identification system for images taken from the International Space Station differs from the identification system for images taken from the Space Shuttle. Each part of the ID number is described below.

International Space Station

ISS 004 . ESC 2 . 066 10 36 26

Mission and Camera Identification

- ISS** International Space Station
- 004** Crew Number
- ESC** Electronic Still Camera
- 2** ISS EarthKAM mission number for this ISS crew

Time of image in Greenwich Mean Time (GMT)

- 066** Day of the year image was taken
- 10** Hours (GMT)
- 36** Minutes (GMT)
- 26** Seconds (GMT)

Space Shuttle

STS 089 . ESC . 07 15 41 37

Mission and Camera Identification

- STS** Space Shuttle
- 089** Mission Number
- ESC** Electronic Still Camera

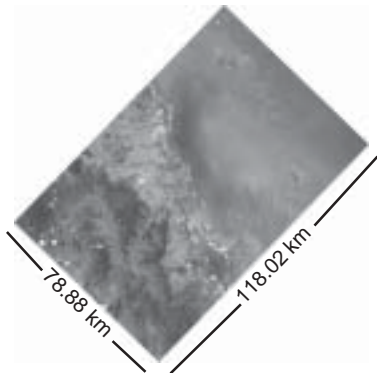
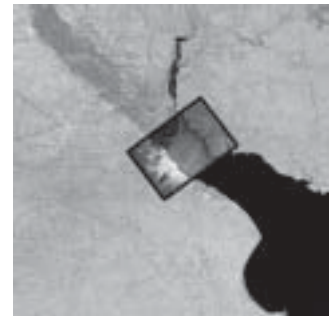
Time of image after launch of Space Shuttle

- 07** Days
- 15** Hours
- 41** Minutes
- 37** Seconds

Image ID numbers should be recorded for any photograph studied.

Location

Latitude and longitude are provided on the back of each lithograph. These coordinates pinpoint the center of the photograph and locate the area on Earth. Latitude and longitude can also be used to find locations on maps. Small maps also appear on the back of each lithograph to help find the image's general location. By comparing the photograph and maps, you can identify the features and learn about the area within as well as surrounding the photograph.



Scale

The scale of an ISS EarthKAM photograph depends on the camera and lens used and the altitude of the ISS or Space Shuttle when the photograph was taken. The back of the lithographs provide the exact dimensions for each image.

North

The top of the page on the colored side of the lithograph is NOT necessarily north. The back side of most lithographs shows the photograph rotated to put north at the top. Knowing which way is north helps to align the photographs with maps and to identify features on the image.

Exploring Earth from Space Worksheet

Name _____

Directions: Answer these questions as you examine an ISS EarthKAM lithograph provided by your teacher.

1. Lithograph title: _____
2. Describe the image:
 - a. What shapes, colors, and patterns do you see?
 - b. What features, such as rivers, mountains, or cities, can you identify?
 - c. What questions do you have about what you see?

Directions: Record the following data using information provided on the back side of the lithograph.

1. Image ID #: _____
2. Center latitude: _____ Center longitude: _____
3. Examine the annotated photograph and read the description. What facts, features, or aspects interest you the most? Why?

Directions: Use the information recorded above and resources such as atlases to answer the following questions.

1. Describe the location of the photograph so that someone else could find it on Earth:
 - a. What country/countries does it show?
 - b. What specific features can be identified?
 - c. What does the surrounding area look like; what does it contain; and how is it used?

2. What questions do you now have about this photograph?

Exploring Earth from Space
with International Space Station (ISS)
EarthKAM Photography

EDUCATOR REPLY CARD

To achieve America's goals in Educational Excellence, it is NASA's mission to develop supplementary instructional materials and curricula in science, mathematics, and technology. NASA seeks to involve the educational community in the development and improvement of these materials. Your evaluation and suggestions are vital to continually improving NASA educational materials.

Please take a moment to respond to the statements and questions below. You can submit your response through the Internet or by mail. Send your reply to the following Internet address:

http://ehb2.gsfc.nasa.gov/edcats/lithograph_set

You will then be asked to enter your data at the appropriate prompt.

Otherwise, please return the reply card by mail. Thank you.

1. With what grades did you use the lithograph set?
Number of Teachers/Faculty:
_____ K-4 _____ 5-8 _____ 9-12 _____ Community College
College/University - _____ Undergraduate _____ Graduate
Number of Students:
_____ K-4 _____ 5-8 _____ 9-12 _____ Community College
College/University - _____ Undergraduate _____ Graduate
Number of Others:
_____ Administrators/Staff _____ Parents _____ Professional Groups
_____ General Public _____ Civic Groups _____ Other
2. a. What is your home 5- or 9-digit ZIP code? _____
b. What is your school 5- or 9-digit ZIP code? _____
3. This is a valuable lithograph set.
 Strongly Agree Agree Neutral Disagree Strongly Disagree
4. I expect to apply what I learned in this lithograph set.
 Strongly Agree Agree Neutral Disagree Strongly Disagree

Fold along line and tape closed.

5. What kind of recommendation would you make to someone who asks about this lithograph set?

Excellent Good Average Poor Very Poor

6. How did you use this lithograph set?

- | | |
|--------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Background Information | <input type="checkbox"/> Critical Thinking Tasks |
| <input type="checkbox"/> Demonstrate NASA Materials | <input type="checkbox"/> Demonstration |
| <input type="checkbox"/> Group Discussions | <input type="checkbox"/> Hands-On Activities |
| <input type="checkbox"/> Integration Into Existing Curricula | <input type="checkbox"/> Interdisciplinary Activity |
| <input type="checkbox"/> Lecture | <input type="checkbox"/> Science and Mathematics |
| <input type="checkbox"/> Team Activities | <input type="checkbox"/> Standards Integration |
| <input type="checkbox"/> Other: Please specify: _____ | |

7. Where did you learn about this lithograph set?

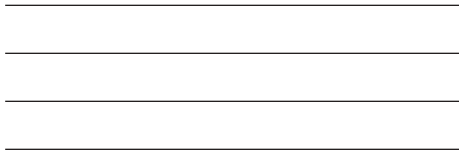
- NASA Educator Resource Center
 NASA Central Operation of Resources for Educators (CORE)
 Institution/School System
 Fellow Educator
 Workshop/Conference
 Other: Please specify: _____

8. What features of this lithograph set did you find particularly helpful?

9. How can we make this lithograph set more effective for you?

10. Additional comments:

Today's Date: _____



Please Place
Stamp Here
Post Office
Will Not Deliver
Without Proper
Postage

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
EDUCATION DIVISION
MAIL CODE FE
WASHINGTON DC 20546-0001**



Fold along line and tape closed.