NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE™

A BIRD'S EYE VIEW / REMOTE SENSING-Part 2

Students will learn what remote sensing is and how it was developed, from the early years of 'pigeon photography' to the latest in satellite imagery. They will also develop an awareness of how things are interpreted within the realm of aerial photography! Please note: Some of the ideas contained within this lesson plan were derived from information obtained from an animated NASA lesson plan entitled ""The Adventures of Amelia the Pigeon" (https://science.nasa.gov/adventures-amelia-pigeon).

LESSON PLAN — Part 2

Learning Objectives
The students will
- Learn about the development of remote sensing with respect to the five senses, focusing on sight
- Learn how to change their thought processes about how objects look from far above (not very easily done)
- Learn how to sketch familiar objects—not how they look from the typical 'side/personal view,' but from a perspective which is high above the object in question
- Understand how and why we changed our mindset from the normal vision of the world (eye level) to that of an aircraft flying in the sky

- Develop an understanding of how to interpret photographs taken from birds, kites, rockets, hot air balloons, aircraft, satellites and spacecraft—and how to interpret textures, colors, geometric shapes, shading and shadows

Introduction/Background

Remote sensing was initially introduced in the late 1950s, and prior to that aerial photography was used and more apropos. Simply stated, remote sensing is the science and acquisition of information about a particular object (identifying, measuring or observing) without making direct, physical contact with that object. Although several of our five senses may be amplified and/or reconfigured to be used in a remote sensing role, for the purposes of this lesson plan, the focus will be on the sense of sight. The history of remote sensing (from the "bird's eye view" perspective) began with the invention of photography. The very first aerial photo was taken in 1858 from a hot air balloon that was floating about 1,200 feet above Paris. During the Civil War, observations were done from balloons for military purposes, and it is also possible that photographs were taken as well. In 1903, the Bavarian Pigeon Corps used pigeons to take aerial photos over Europe. The cameras which were strapped to them were activated by timing mechanisms. Cameras were affixed to kites to photograph the San Francisco earthquake of 1906. During World War I, aerial photography was accomplished from airplanes, as it was during World War II (although, more sophisticated techniques existed).

Grade Level: 2—4

Ohio Learning Standards/Science (2018)
Expectations for Learning
Nature of Science

Earth and Space Science
4.ESS.1: Earth's surface has specific characteristics and landforms that can be identified.

Ohio Learning Standards/Fine Arts (2012)
Fine Arts: Grade 3:
3PR: Find and solve problems of personal relevance and interest when developing art making ideas
4PR: Create artworks that demonstrate awareness of two- and three-dimensional space.

Ohio Learning Standards/Social Studies (2019)
Grades 2 through 4:
History: Historical Thinking and Skills
Geography: Spatial Thinking and Skills

Ohio Learning Standards/Mathematics (2017)
Geometry:
2.G: Reason with shapes and their attributes
3.G: Reason with shapes and their attributes

Materials Required:

- Board and markers
- Laptop, monitor, digital projector
- Paper and pencils for each student

And the first photographs of Earth from space were made by a camera riding aboard an American-launched V-2 rocket in 1946. After World War II ended, a climate of distrust and political unrest existed between the Soviet Union and the United States—the Cold War. The very first overflight of the Soviet Union by a U-2 spy plane was in 1956, and this aircraft did an adequate job taking secret, aerial reconnaissance photos for the Central Intelligence Agency (CIA) for several years. However, on May 1, 1960, Francis Gary Powers was shot down by surface-to-air (SAM) missiles while flying over the Soviet Union, and our secret reconnaissance missions were exposed. President Eisenhower was forced to admit to our aerial spying.

CORONA Program satellites, first launched in 1960, contained the first American high-resolution space reconnaissance system (the American public didn't know of the program's existence until 1995 when it was finally declassified – it was known to the public at the time as the Discoverer XIV research program). The first satellites in this program took photographs of wide swaths of land to identify items such as airfields and missile sites of foreign military and nuclear powers. But we still needed an aircraft to replace the U-2 that would help us see if the Soviet Union, as well as other countries, was developing the types of weapons that could be used against us. It would have to be a long-range, supersonic, photo-reconnaissance aircraft. It would have to be able to fly faster than Mach 3 (more than three times the speed of sound) for hours at a time. It would have to reach an altitude in excess of 85,000 feet (over 16 statute miles). It would have to be able to photograph up to 100,000 square miles of the Earth's surface per hour. Such an aircraft could fly high enough and fast enough to avoid SAM missiles, and it could also fly higher and faster than any enemy fighters or interceptors.

The CIA turned to the makers of the U-2, Lockheed Martin's "Skunk Works" in Burbank, California, to design and build this aircraft. The first of these very special aircraft were designated A-12s, and they were three decades ahead of any other jet airplanes. These "Blackbirds" first flew at the secretive Area 51 in Nevada, in April of 1962. In July of 1964, President Johnson announced the SR-71 Blackbird Program to the world—and every aforementioned requirement was met or exceeded by the SR-71. In the 1960s and early 1970s, Gemini and Apollo astronauts took hundreds of photographs of the Earth, the moon and space from their spacecraft and from the moon! And between 1971 and 1986, HEXAGON KH-9 reconnaissance satellites were the largest (and last) U.S. intelligence satellites to return photographic film to earth. During the Cold War, 19 HEXAGON missions imaged 877 million square miles of the Earth's surface. In 1972, the first Earth Resources Technology Satellite (ERTS-1) was launched by the National Aeronautics and Space Administration (NASA). It was later renamed Landsat-1, and its primary objective was to obtain information on agricultural and forestry resources, land cover, land use, geology and mineral resources, hydrology and water resources, environmental pollution and marine resources! In the late 1990s, the USAF started flying the unmanned Predator vehicle which used satellite data links to gather information which could be shared instantaneously with commanders around the world. About the same time, the US first flew another unmanned aerial vehicle, the Global Hawk, with its powerful digital camera and infrared sensor that can gather imagery in any weather condition, day or night. Through satellite links and ground relay stations, that information is transmitted immediately anywhere in the world. Its "Synthetic-Aperture Radar/Moving Target Indicator" lets ground crews track even small, moving objects on the ground. In 2001, Google Earth was released – a computer program that provides a 3-D representation of our planet based primarily on satellite imagery and aerial photography!

Procedures for Birds Eye View – Part 2

- Ask the students to name all of our five senses, and write them on the board. Tell them that several of the senses can be enhanced electronically (such as hearing aids) but announce that you are going to focus on sight for the purposes of these lesson plans!
- Tell the class that currently, when we want to take a picture from above (aerial photography), we use regular airplanes, 'spy' planes, helicopters, drones and satellites which orbit the Earth. But HOW did people take aerial photographs over 100 years ago.

- Go through the accompanying slide presentation (using background information above which is also available on the notes pages of the slides). Skip slides 13 through 17 (satellite information) for Part 3.
- Then, beginning with the slide of the side view of the Pentagon, give the class a bit of practice using clues to try to determine what these side view and bird's eye view photos represent: the first one shows the normal view of the Pentagon in Arlington, VA. The class probably won't be able to tell what this famous building is from the side. However, looking at it from the bird's eye view perspective students should be able to notice things such as the shape of the building, the dark trees in the middle of the complex, the many cars in the parking lots and all of the expressways leading to and from the building (including a large 'cloverleaf' formed as part of one of the highway systems). The next slide shows a bird's eye view of another famous building in Washington, DC— ask students to give you clues that they see (including shading, shadows, shapes and texture). Yes, it is the Washington Monument. The next slide is filled with geometric shapes, textures, colors and shadows—ask if anyone knows the name of the island (Liberty Island) and what famous monument is on it (the Statue of Liberty)! A person's perspective/side view of the famous statue is revealed in the next slide. On the next slide—have students raise their hands when they wish to share one thing/one clue they can see. Examples may include: the trees have lost their leaves, the fans look like colorful marbles, there are football players, cheerleaders, a scoreboard, the football field forms a huge rectangle and the stadium forms a large oval—it is the University of Montana's crowded football stadium! Next are two fighter jets flying over a city—ask students what clues they see that will help them determine what capital city is shown (such as pyramids, sand, etc.). Some students will know that it is Cairo, Egypt! Skip slides 26 through 30.
- Go back to the slide showing the SR-71 in flight. This image is from above. Have the students try drawing the SR-71 from the side or the front. Give the class ample time and only assist students who are having difficulty perceiving what the airplane might look like. When students are finished, show the last slide in the presentation (showing an SR-71 from the side and from the front).

This concludes Part Two of this lesson.

Resources:

NASA's Amelia the Pigeon website: https://science.nasa.gov/adventures-amelia-pigeon

Another lesson plan using Amelia the Pigeon:
https://www.univie.ac.at/geographie/fachdidaktik/FD/site/external_htmls/imagers.gsfc.nasa.gov/amelia/index.html
And the teacher guide:
https://www.univie.ac.at/geographie/fachdidaktik/FD/site/external_htmls/imagers.gsfc.nasa.gov/amelia/teachersguide/lessonsK_2/K-2Lesson1.html

ERTS: https://landsat.gsfc.nasa.gov/landsat-1/

Google Earth: https://www.google.com/earth/

Background resources from the National Museum of the USAF (https://www.nationalmuseum.af.mil/**):**

- Homing Pigeon: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197423/USAFmuseum/

- U-2: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195974/lockheed-u-2a/

- SR-71: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/198054/lockheed-sr-71a/

- Reconnaissance Satellites:

  - https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/198108/discoverer-xiv/
  - https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195920/gambit-1-kh-7-reconnaissance-satellite/
  - https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195922/gambit-3-kh-8-reconnaissance-satellite/
  - https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195921/hexagon-kh-9-reconnaissance-satellite/
  - https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/589823/teal-ruby/