Kids as Airborne Mission Scientists

Lesson overview: Collecting Images: What happens in a live mission?

FRAME	INFORM	EXPLORE	TRY	SUPPORT
Students view the AVIRIS image of Kailua Bay and begin to think about the process of collecting data.	Students are divided into two groups: "rig" builder and kite "pilot." They build the rig, plan the mission, and practice flying kites.	Students are divided into teams to explore the data collection process while participating in the mission.	Students plan remote sensing data collection for the KaAMS mission. After data are collected they will review their data collection plan.	Support materials for the teacher include ideas to promote student reflection, sample answers to activities, and extension of ideas.

Click on FRAME, INFORM, EXPLORE, TRY, or SUPPORT above to view the detailed lesson plan.

Lesson context: To motivate students in KaAMS, they are given an opportunity to participate in the live data collection process. The goal of this lesson is for students to develop an understanding of remote sensing data collection while taking part in the kite aerial photography activity and the flight flown by the Pacific Disaster Center. Students work in groups to plan the process of collecting data that they will analyze in order to evaluate the state of coral reefs in the Kailua Bay.

Key science concepts:

- The design, construction, use, and analysis of a real remote sensing system using Kite Aerial Photography.
- The understanding of scientific management of coral reefs using Pacific Disaster Center flight.

Links to teacher resources:

- Kite Aerial Photography

Problems addressed in this lesson:

- What preparations are necessary prior to collecting airborne remote sensing data?
- What decisions need to be made when planning to collect data during a mission?

Activity bursts:

- How to build a rig
- Planning to fly a kite-- aerial photography mission
- Role-playing of the PDC flight

Links to other resources:

Lesson	Teacher	Students
INFORM	Kite Aerial Photography Rig http://education.ssc.nasa.gov/kap/kap.htm	Kite Aerial Photography Rig http://education.ssc.nasa.gov/kap/kap.htm
EXPLORE	Pacific Disaster Center http://www.pdc.org/	Pacific Disaster Center http://www.pdc.org/
	The mission of PDC center http://www.pdc.org/pdc/pub/GeneralInformation/mission.html	The mission of PDC center http://www.pdc.org/pdc/pub/GeneralInformation/mission.html
	Q & A about the PDC http://www.pdc.org/pdc/pub/GeneralInformation/faq.html	Q & A about the PDC http://www.pdc.org/pdc/pub/GeneralInformation/faq.html
	ER-2 Flight Operations http://www.dfrc.nasa.gov/airsci/er-2/fltops.html	ER-2 Flight Operations http://www.dfrc.nasa.gov/airsci/er-2/fltops.html
	Outline of flying the MS data set in Kailua Bay http://www.soest.hawaii.edu/GG/STUDENTS/ebitari/ebitari9.html	Outline of flying the MS data set in Kailua Bay http://www.soest.hawaii.edu/GG/STUDENTS/ebitari/ebitari9.html
TRY	The weather map in Hawaii http://lumahai.soest.hawaii.edu/cgi-bin/satview.cgi?sat=g10&satregion=oah&channel=nv1&size=stand&anim=yes	The weather map in Hawaii http://lumahai.soest.hawaii.edu/cgi-bin/satview.cgi?sat=g10&satregion=oah&channel=nv1&size=stand&anim=yes

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Collecting Images: What happens in a live mission?

Related subject area: Science

Overall problem: Which activities (if any) should be restricted around the coral reefs of Kailua Bay to insure their lasting protection?

Relationship of the problem in this lesson to the overall problem: To evaluate the state of coral reefs, students need to collect the AVIRIS images over Kailua bay. The goal of this lesson is for students to develop understanding of collecting data while participating in the live mission. To attain this objective, students will participate in hands-on activities on collecting data using kite aerial photography and playing the roles of the Pacific Disaster Center(PDC) responsible for the flight. Based on their new understanding of data collection, students will plan the process of collecting data for the KaAMS mission and analyze their plan.

Estimated time required: 2 to 3 class periods

Student outcomes/objectives:

- The students will be able to plan a mission to fly and remotely sense the coral reefs of Kailua Bay by participating in the PDC flight.
- The students will construct a remote sensing kite "rig" or develop kite piloting skills.

Prerequisite skills or knowledge:

- Basic Internet skills
- Basic reading and writing skills
- Basic understanding of problem solving

Teacher preparation:

- Print Student Journal /Activity sheets for these activities.
- Bookmark appropriate websites for students.
- Obtain kites.
- Secure computers, scanner, and Internet access as well as projection equipment.

Student reflection and assessment: **Student reflection activity** | **Assessment**

Education standards supported by this lesson:

National Science Education Standards | Project 2061 Benchmarks

National Standards for School Mathematics | National Technology Standards | National Geography Standards

Cross-curricular connections to National Education Standards for this lesson:

Math | Technology | Geography

Teacher activities		Student activities
Frame the lesson by providing the collected images **Show** students **image1 and image 2** collected by airborne remote sensing and satellites. **Ask** what the images are and what the difference between two images is. **Prompt** students to think about what they have been investigating. • Ask what the overall problem is. • Ask which aircraft and remote sensing instrument they chose for the KaAMS mission. • Ask which factors they considered when planning the remote sensing mission. **Stimulate** and facilitate a discussion about the manner in which the data may have been		Student Activity: • Student view images from remote sensing missions and think Sample students responses • Kailua Bay images • Image 1 is an AVIRIS airborne image. It covers a smaller spatial area but has more detail. • Image 2 is a satellite (Landsat) image. It covers a larger spatial area but has less detail. • Evaluating the state of coral reefs of Kailua Bay and make recommendations to the Congress Research Service. • ER-2 aircraft and AVIRIS sensors were used. • Weather, flight route, arrival airport, etc aircraft, satellite, etc

collected.
 	
Ask students how these data were collected?
		• aeronautics, propeller aircraft, satellite imagery, balloons, kites, etc.
		  ○ The AVIRIS airborne image was collected onboard an ER-2 aircraft (for more info on capabilities and performance see http://www.dfrc.nasa.gov/airsci/er-2/er2perf.html)
		  ○ The Landsat satellite image was collected onboard the Landsat 7 satellite (for more info on Landat 7 satellite see http://ltpwww.gsfc.nasa.gov/landsat7/ls7background.html)

Teacher activities		**Student activities**
INFORM the students that they will be split into groups to build a kite aerial photography and develop the skills necessary to fly an airborne remote sensing mission and collect the data (Optional Activity). **Teacher Note**: The aim of kite aerial photography activity is to stimulate students' interest for collecting data and will take 2-3 class period to complete it. Therefore, If you don't have enough time to do this activity, you can skip this activity and move to the EXPLORE part or explain the main activity to the students to simplify this activity. **Divide** students into groups and have them split their team into two roles: "rig" builders and kite "pilots". See **Activity sheet: Team Assignment (CD-1)** • Activity - Building the rig: Guide the rigging students through the process of building the "rig" using a projection panel to demonstrate the step-by-step process as described on the website.		Student activity: • Divide students into groups. See **Activity sheet: Team Assignment (CD-1)** • Students read/ view the explanation for building rig in "how to" web site. • Students brainstorm mission flight plan and necessary piloting skills.

• Activity - Planning for flying a kite aerial mission: Prompt "pilot" students to develop a flight plan for the mission and a list of skills the "pilot" needs to fly a controlled mission. **Facilitate** team activity. • Guide rigging team as they build the rigs. • Prompt pilot team plan a mission while the rigging team builds the rigs. They should identify on a target on the school grounds for taking aerial photographs and describe the conditions necessary for the flight. See **Activity sheet: Mission planning (CD-2)** • Guide pilot teams as they have practice flying kites without the camera in place.		• "Rig" team will build the rig. • "Pilot" team will plan the mission. See **Activity sheet: Mission planning (CD-2)** • Students develop their kite flying skills and practice for the mission.
Teacher activities		**Student activities**
Explore the mission of Pacific Disaster Center. **Prompt** students to look at the AVIRIS images taken over Kailua bay and answer the following questing: • When were these images collected? • What was the remote sensing target? • How did we get these kinds of data?		Sample students response: • April 12, 2000 • Kailua Bay • 1) Planning included identifying the mission and coordinating preparations among the people who work for the mission.

• Who collected this image? **Provide** the information about the Pacific Disaster Center (PDC) and ask students to identify the mission of PDC center **Prompt** students to think about how the PDC center is related to the KaAMS mission and why they should collect the remote sensing data in Kailua Bay based on the direction of the PDC director. **Elicit** from the kids the roles of the people who are involved at the process of collecting data in the live mission by having them to think about the people who work in the		• 2)Flying a mission included flying from NASA Dryden Center at Edwards Airforce Base, landing at the Honolulu airport, flying to the Kailua Bay, turning on the remote sensing instrument, collecting the data, turning off the remote sensing instrument, and returning to Honolulu. • 3) Analyzing data: data collected analyzed. • Pilot, Principal Investigator(P. I.), Grounded-based person(Mission Controller), etc • View the websites of PDC center • Research Background ○ Q & A about the PDC • The mission of PDC centers is to 1) provide valuable and timely information products and service for comprehensive emergency management in and around the Pacific and Indian Ocean regions, 2) address all phases of emergency management, 3) serve as a model for global, regional, and local initiatives in disaster information management, 4) serve as a test - bed for science, technology, and organizational process. • Kailua Bay is part of Oahu Islands, Hawaii which is in the Pacific region of the world. So by mapping the Bay, we are contributing to the acquisition of timely information in the Pacific. • Unhealthy reefs are indicators of future emergency hazards such as (1) loss of fish which leads to loss in

PDC. **Prompt** students to think about the main role of each person who participate in the mission of collecting data by having them look at the ER-2 Flight Operations **Teacher Note**: 1. You may want to remind students about the description of a flight plan in the lesson plan "How do I Develop the Flight Plan" for this activity. 2. Supplementary activity: You may want to have students to look at the actual data collection process over Kailua Bay by showing the following websites ○ Outline of flying the MS data set in Kailua Bay		the fishing trade and eventually to loss in this area of the food supply and (2) loss of the coral reef which protects the coastline from erosion by large waves. Therefore, PDC can be a center for the mission collecting remote sensing data over Kailua Bay. • Pilot, Principal Investigator (P. I.), Ground-based person (Mission Controller), etc • Examine ER-2 Flight Operations • Pilot will review flight path, altitude, technical issues, etc. • Principal Investigator will make clear what the scientific objectives of the mission are. • Ground-based person will make sure that everything is in order and that the weather is appropriate for flying.
Teacher activities		**Student activities**
Try to plan the process of data collection for the KaAMS mission. **Break** students into several groups and assign the different role including pilot, P.I., and Ground-based person to a member of each group. **Ask** each person who takes a different role in the group to plan the process of collecting		

data for evaluating the state of coral reefs of Kailua Bay while examining the weather map in Hawaii and write the answers to the following question in the **Activity sheets: Planning the data collection over Kailua Bay (CD-3)** **Teacher Note:** Weather map shows cloud cover over the island of Oahu. Check to make sure that the target over Kailua Bay is clear. You may want to refer to the map (http://www.soest.hawaii.edu/GG/STUDENTS/ebitari/Research/Oahu_map.jpg) to refresh your memory about the location of Kailua Bay with the map • What are your plans for preparing and implementing the data collection mission? • What are the factors to be considered when planning the data collection mission based on your role? • How can you collaborate with other persons in your group in order to collection data? **Ask** each member who has taken a different role to present their plan about collecting data in their group. **Ask** each group to present their data collection plan. **Debrief** the students about how well they think the mission will be • Ask students to predict whether their mission will be successful in the eyes of each personnel involved. • What would we do after collecting data? **State** in the next class they will begin to analyze the collected data.		Sample students responses: • View the weather map in Hawaii . Students write the results of their investigation in **Activity sheets: Planning the data collection over Kailua Bay (CD-3)**

Student reflection activity:

- Prompt students to think about how the kite aerial photography activity is related to the live mission
- Prompt students to think about how the mission of PDC center is related to the KaAMS mission.
- Prompt students to think about what aspects of the mission did or did not work during Kite aerial photography activity and the PDC mission role-playing

Assessment:

- Check the process of building the rig.
- Check how well students collaborated as a team member.
- Check student's rationale for planned mission: time, weather conditions, flight duration, and target of remote sensing.

Ideas for math lesson connections

- Students complete a cost analysis of the materials needed to construct the "rig" and obtain the kite.
- Students' measurement skills can be enhanced throughout the construction of the "rig" and this might be a good opportunity to have them use some precision measuring tools such as calipers or micrometers.
- Students combine their analytical and spatial skills by constructing the "rig."

Related National Education Math Standards

- Measurement
- Problem solving

Ideas for geography lesson connections

- Students study the effect of weather conditions on kite flight. Students can then research local weather patterns to determine the best time to fly their kite aerial photography mission.
- Students create a map of the school grounds and identify a flight path and target points. Students can create grids to identify locations similar to latitude and longitude.

Related National Education Geography Standards

- The World in Spatial Terms (#1)
- The Uses of Geography (#18)

Ideas for technology lesson connections

- Word processing: Students create their own electronic journal for keeping notes on KaAMS project.
- Database: Students create a database of vocabulary words and terms they will learn throughout KaAMS.
- Presentation software: Students create a short presentation on their understanding of airborne remote sensing.
- Students use image processing software to identify, enhance, crop and label objects.
- Students identify physical constraints such as weather, range to the target, skills to operate the kit and "rig," and use the constraints in the process of interpreting the collected data.

Related National Education Science Technology Standards

- Nature of technology (3)
- Technology and Society (6)
- Design (8)
- Abilities for a Technological World (11)
- The Designed World (17)

Activity Sheet : Team assignments (CD-1)

Name:

_____

Task 1: Assign team member to roles.

Rigging Team - Skills Pilot	Mission Planning - Skills
Team members	**Team members**

Activity sheet: Mission planning (CD-2)

Task 2: Mission planning.

Be sure to address the following questions:

- What is the target for the mission?
- What conditions are necessary for the mission?
- When will the mission be flown?
- Will there be practice flights? When? How long?
- Who will coordinate the mission? How?
- How will the data be analyzed? Who will analyze the data? How will it be reported?

Activity sheet: Planning the data collection over Kailua Bay (CD-3)

1. What are your plans for preparing and implementing the plan for data collection?

Step	Principal Investigator	Pilot	Ground Person
Preparing Data Collection	1. Know the objective of the mission (Ex. the mission is to collect Airborne Remote Sensing data of Kailua Bay) 2. Draw out the flight lines that you want the pilot to fly. (this exercise has been done in Try section of lesson 10 Developing a Mission Flight Plan -- When and Where do I Fly?) 3. Watch the weather maps to see when there will be an open weather window to fly the mission. (Note: Weather map shows cloud cover over the island of Oahu. Check to make sure that the target over Kailua Bay is clear to refresh your memory about the location of Kailua Bay. You may want to refer to http://www.soest.hawaii.edu/GG/STUDENTS/ebitari/Research/Oahu_map.jpg.) 4. Maintain communication with the other members	1. Ensure that you are able to fly the area asked of you by the P.I. (For example, are there any considerations to flying in that area, like high mountains?) 2. Determine how long it will take to get to the study area from the take-off point at the airport. (Communicate with P.I. who is drawing out flight plans. Refer to lesson 10 in Support section at http://www.higp.hawaii.edu/kaams/lpref/develop/support.html under Activity sheet: Flight planning table (DMFP-6) 3. Consider that aircraft is able to fly at the altitudes required. 4. Consider that aircraft is able to fly in the current wind conditions (see http://weather.noaa.gov/weather/current/PHNL.html and compare wind speed to the maximum wind speeds allowed	1. Prepare to take notes about the conditions on land in the study area during the flight of the mission overhead. 2. Prepare the devices for deployment. If there are complicated devices to be set up, the Ground Personnel might want to practice the deployment before hand. 3. Check to make sure he or she is available to work when needed.

	of the team (Pilot and Ground Personnel) as you are the leader of the mission. 5. Think about if you want any other measuring devises on the ground.	while flying (see http://www.dfrc.nasa.gov/airsci/er-2/fltops.html under heading of runway condtions) 5. Consider technical issues (e.x. Does the aircraft have fuel? Is it in good working condition?)	

Activity sheet: Planning the data collection over Kailua Bay (CD-3A)

2. What are the factors to be considered when planning the data collection mission based on their role?

Step	Principal Investigator	Pilot	Ground Person
Factor to be considered	1. How much budget do we have? 2. What kind of time issues do we have? Do all the other members of the team are available for the data collection ? 3. Have I taken care of paying the team members? 4. Are all the team members clear on what they have to do? Do they all understand the goal of this mission?	1. Am I available to fly at any time? 2. Is the plane in good flying condition? 3. Do I understand where the P.I. wants me to fly? 4. Are my credentials to fly current? 5. Am I okay with how much I am being paid?	1. Do I know where I am supposed to be on the day of the mission? Do I know where the study site is? 2. Do I know how I will get to the study area? 3. Do I know how to deploy all the instrumentation needed? 4. Do I have a way to take notes about the conditions of the day for archive purposed.

Activity sheet: Planning the data collection over Kailua Bay (CD-3B)

3. How can you collaborate with other persons in your group in order to make a complete data collection plan?

1. Lots of communication among group members.
2. Everyone has to be clear on what their duties are during the mission.
3. Everyone needs to carry out their assigned duties