

Kids as Airborne Mission Scientists

Lesson overview: What conclusions can I draw and how do I present my results?

FRAME

Students remember the overall problem and begin to think about how their different roles impact their conclusion.

INFORM

Students begin to think about their conclusions based on a given role and how to present their recommendation.

EXPLORE

Students work in groups to draw their conclusions while exploring their role and the results of the data analyses. They also review assessment criteria for successful projects while they make final adjustments for their project presentations.

TRY

Student teams present their recommendations to be submitted to Congress. The class participates in providing feedback.

SUPPORT

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: This lesson plan provides students with the time to wrap up their investigation for the KaAMS mission. Students are divided into groups to take on different roles such as coastal developer, commercial fisherman, tourist, coral reef expert, and native Hawaiian representative. Each group prepares a report or presentation based on their role, which summarizes their recommendations, predictions, inferences, or resolution to the Kailua Bay coral reef problem. The activity ends with student's presentations to the class and sharing of feedback among teams.

Key science concepts:

- Scientific process, sharing results

Links to teacher resources:

- [How to prepare a poster](#)
- [How to present a poster session](#)
- [Create your own website](#)
- [Resources for websites](#)
- [Extensive tips on creating websites](#)

Problems addressed in this lesson:

- What is a recommendation, prediction, inference, or resolution to the Kailua Bay coral reefs problem?

- What is the best way to present findings to the questions: Which activities (if any) around the coral reefs of Kailua Bay should be restricted to insure their lasting protection?

Activity bursts:

- Creating posters for poster sessions - tips [\(1\)](#) | [\(2\)](#)
- Designing web sites to present work - tips [\(1\)](#) | [\(2\)](#) | [\(3\)](#)
- Writing scientific reports - tip
<http://www.wisc.edu/writing/Handbook/ScienceReport.html>
- Role playing for drawing up their final conclusions.

Links to other resources:

Lesson	Teacher	Students
INFORM	Creating posters for poster sessions http://educ.queensu.ca/~ar/poster.htm	Creating posters for poster sessions http://educ.queensu.ca/~ar/poster.htm
	Designing websites to present work http://www.smplanet.com/webpage/webpage.html http://www.bham.wednet.edu/class2.htm http://info.med.yale.edu/caim/manual/contents.html	Designing websites to present work http://www.smplanet.com/webpage/webpage.html http://www.bham.wednet.edu/class2.htm http://info.med.yale.edu/caim/manual/contents.html
	Writing scientific reports http://www.wisc.edu/writing/Handbook/ScienceReport.html	Writing scientific reports http://www.wisc.edu/writing/Handbook/ScienceReport.html
EXPLORE	Rubrics for posters http://cte.jhu.edu/techacademy/fellows/Hammond/WebQuest/WQIPR.html http://www-ed.fnal.gov/trc/rubrics/poster.html	Rubrics for posters http://cte.jhu.edu/techacademy/fellows/Hammond/WebQuest/WQIPR.html http://www-ed.fnal.gov/trc/rubrics/poster.html
	Rubrics for websites http://edtech.sandi.net/rubric/	Rubrics for websites http://edtech.sandi.net/rubric/
	Rubrics for scientific report http://www.smcps.k12.md.us/mbms/rubric.html	Rubrics for scientific report http://www.smcps.k12.md.us/mbms/rubric.html

	<p>Rubrics for overall large projects http://www.glenbrook.k12.il.us/gbssci/physics/projects/yep/endoyrub/yeprub.html http://www.bham.wednet.edu/mod8low.htm</p>	<p>Rubrics for overall large projects http://www.glenbrook.k12.il.us/gbssci/physics/projects/yep/endoyrub/yeprub.html http://www.bham.wednet.edu/mod8low.htm</p>
	<p>Rubrics for presentation skills http://ekcs.neric.org/~jbuckley/rubrics/oralrprubric.html http://www-ed.fnal.gov/help/97/sightsound/resdirub.html</p>	<p>Rubrics for presentation skills http://ekcs.neric.org/~jbuckley/rubrics/oralrprubric.html http://www-ed.fnal.gov/help/97/sightsound/resdirub.html</p>
	<p>How are coral reefs important to us? http://www.higp.hawaii.edu/kaams/lpreef/crimportant/support.html</p>	<p>How are coral reefs important to us? http://www.higp.hawaii.edu/kaams/lpreef/crimportant/support.html</p>

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What conclusions can I draw and how do I present my results?

Related subject area: Science

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

Relationship of the problem in this lesson to the overall problem: Students have been working through a process to identify issues, research information, explore new scientific concepts, gather and analyze data, and summarize findings. During this lesson, students complete the research cycle by drawing conclusions based on their assigned role. This session provides students with an opportunity to summarize and reflect on the work they have done in KaAMS and share it with others. At this point they can describe how they researched the issues, what they learned, and what conclusions they can draw about the overall problem.

Estimated time required: 2 to 3 class periods.

Student outcomes/objectives:

- Students will write a report for Congress that includes a) problem scenario and roles, b) methods used to study, c) images collected, and d) conclusions.
- Students will select which image is best for illustrating the conclusion they draw based on their assigned roles.
- Students will identify the value of the coral reef ecosystem to life.
- Students will know what recommendations and predictions are.

Note: Up to this point, students have been working in groups to document their investigations throughout the unit. It is your option to allow class time for students to create a poster, web site, multimedia project, or scientific report that presents their findings and the work they did to reach those conclusions or assign final project preparation as homework.

Prerequisite skills or knowledge:

- Basic internet skills
- Analysis of the remote sensing data

- Final project assessment rubrics
- Skills required to meet the project demands, e.g., visual design for posters, html skills for the web project, writing skills for scientific reports
- Basic presentation and explanation skills

Teacher preparation:

- Print Student Journal / Activity sheets for these activities.
- Provide appropriate materials for poster construction or to develop specified final product.
- Bookmark web sites with tips and suggestions from real-world presenters on making good posters for poster sessions.
- Print rubrics being used to assess projects and presentations.
- Schedule presentation session, space required, etc.
- Invite parents and guests to the presentation sessions.

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
<p>FRAME the lesson by explaining to students that they have completed their investigations and analyzed the NASA data. It is time for them to draw conclusions and present their results.</p> <p>Ask students to think about the overall problem and processes that they have used in order to address the problem.</p> <ul style="list-style-type: none"> • What problem have we been 	<p>Sample student answers:</p> <ul style="list-style-type: none"> • Evaluation of the state of coral reefs in

<p>studying?</p> <ul style="list-style-type: none"> • Why do we need to study this problem? • Where is the study area? • How did you study this problem? • When were the data collected? Which data did you use to evaluate the state of coral reefs? • What groups were concerned about this problem? • What role did you take as an airborne scientists? <p>Prompt students to think about how their role can impact their conclusion to the coral reef problem?</p> <ul style="list-style-type: none"> • What is the overall problem? • What conclusions did you draw? • Which activities around the coral reefs of Kailua Bay should be restricted to insure their lasting protection? Do you expect that all concerned groups draw the same conclusions to the coral reefs problem? How can we draw our conclusions 	<p>the Kailua Bay.</p> <ul style="list-style-type: none"> • It was an mission request from a Government Agency. • Kailua Bays on the island of Oahu in Hawaii. • Based on available airborne remote sensing data, we evaluated the state of coral reefs in the Kailua Bay. • October, 2001. We also used past data from years 1998 and 2000. • Coastal developer, Fisherman, Tourist, Coral reefs expert, Government, etc • Coastal developer, Fisherman, Tourist, Coral reefs expert. • Which activities (if any) around the coral reefs of Kailua Bay should be restricted to insure their lasting protection? • There should be a restrictions to the coral reefs of Kailua Bay to preserve the coral reefs. • Each group may draw different conclusions because they have different concerns on the coral reefs problems.
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Teacher activities	Student activities
<p>Inform students that they will draw their conclusions and make their recommendations based on their assigned roles.</p> <p>Remind students that they have investigated the KaAMS mission based on their assigned roles.</p> <p>Break students into groups, assign each group to different roles, and remind each group of the perspective of their role.</p> <ul style="list-style-type: none"> • GROUP 1: Coastal developer • GROUP 2 Commercial fishermen • GROUP 3: Tourist • GROUP 4: Coral reef expert • GROUP 5: Native Hawaiian representatives <p>Inform students that they will be given class time to create their final project and should be making their final preparations to present their projects to the public.</p> <p>Refer students to the sites to be considered for their final product.</p> <ul style="list-style-type: none"> • Here are sites with tips and suggestions for creating posters for poster sessions: <ul style="list-style-type: none"> o How to prepare a poster o How to present a poster session • Here are sites with tips and suggestions for designing websites to present work: <ul style="list-style-type: none"> o Create your own website o Resources for websites o Extensive tips on creating websites • Here are sites with tips and suggestions for writing scientific 	<p>Student activity:</p> <ul style="list-style-type: none"> • Each student works in their groups. • Students investigate methods for producing and presenting the final project while examining the web sites.

reports: o Writing reports (http://www.wisc.edu/writing/Handbook/ScienceReport.html)	
Teacher activities	Student activities
<p>Explore content by finalizing projects. Students explore the data analysis and their roles in order to draw their own conclusions. They also review assessment criteria and guidelines for successful projects while they make final adjustments for their project presentations: a) Creating poster, b) Designing websites, c) Writing scientific reports, etc.</p> <p>Ask each group to define their role, study the relationship between their role and coral reefs, and examine the importance of coral reefs to them by remembering the activity sheet: an overall table with all different perspective in the lesson "how are coral reefs are important us."</p> <p>Ask each group to work with their given roles to draw their conclusions and make recommendations about the overall problem, "Which activities (if any) around the coral reefs of Kailua Bay should be restricted to insure their lasting protection?".</p> <p>Prompt students to think about the elements to be included when prepare the final report or presentation.</p> <p>Distribute appropriate assessment rubrics to help students design appropriate projects and</p>	<p>Student activities:</p> <ul style="list-style-type: none"> • Students work in their teams while examining their roles. • Students work in their teams to make final report. <p>Sample student answers:</p> <ol style="list-style-type: none"> 1. The problem 2. Roles 3. Methods used to study 4. Images collected 5. Image analysis method 6. Conclusion <ul style="list-style-type: none"> • Students review assessment rubrics to help them prepare their final project.

to meet project expectations. Here are sites with sample rubrics for assessing:

- Posters
 - o [#1](#) Generic example of research poster
 - o [#2](#) Generic example of research poster (more details than #2)
- Websites
 - o [#1](#) Web page design
- Scientific reports
 - o [#1](#) Research paper assessment
- Overall large projects
 - o [#1](#) Year end project scoring (literature review - presentation)
 - o [#2](#) Steps to the research cycle
- Presentation skills
 - o [#1](#) Oral participation rubrics
 - o [#2](#) Discussion of results

Teacher note: The best practice for using rubrics as an assessment tool is to share them with your students prior to beginning projects, papers, etc.

Ask each role group to prepare [their final report or presentation](#) (C-1) while exploring their roles, data analysis results, and presentation style.

Teacher note:

The kids need to remember to put themselves in their respective roles (i.e. coastal developer, commercial fisherman, etc.) but with the mindset of a remote sensing scientist. Whatever position they take, they must be able to defend the position with scientific data (or lack thereof) and appropriate web

Student activities:

- Each group will prepare [their final report or presentation](#) (C-1).

<p>from the class.</p> <p>Summarize the lesson by making <u>A final conclusion</u> to be submitted to Congress(Optional activity).</p>	
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Student reflection activity:

- Prompt students to think about which image is best for illustrating their conclusions and recommendations.
- Prompt students to think about how their role impacts their recommendation for the final paper.
- Prompt students to identify the value of coral reef ecosystems to life.
- Prompt students to think about their favorite experience in their work with KaAMS.

Assessment:

- Check the key content to be covered in the presentation:
 - o Problem definition
 - o Key questions to investigate
 - o The characteristics of aircraft and remote sensing instrument
 - o Plan for the investigation
 - o The process of data collection
 - o The process of data analysis
 - o Drawing conclusions and making recommendations
- Check the evidence supporting their results.
- Check the evidence of team collaboration during the project.

Ideas for math lesson connections

- Students create several of graphs, diagrams, and charts for their presentations to summarize important relationships, organize their thinking, and support their conclusions.

Related National Education Math Standards

- Communication
- Representation

Ideas for geography lesson connections

- Students use maps and other geographic representations such as the classification maps to support their conclusions presentation.

Related National Education Geography Standards

- The World in Spatial Terms (1)
- Places and Regions (4)

- Human Systems (13)
- Environment and Society (14)
- The use of Geography (17, 18)

Ideas for technology lesson connections

- Word processing: Students create their own electronic journal for keeping notes on coral reefs project.
- Spreadsheet: Students create various graphs to summarize information on coral reefs
- Graphics: Students create pictures of Hawaiian Islands, remote sensing missions, aeronautics.
- Presentation software: Students create a short presentation on their understanding of airborne remote sensing.
- Web development: Students begin to develop a web-site to report their progress and what they learn during the coral reefs project.

Related National Education Science Technology Standards

- Nature of Technology (3)
- Design (10)
- The Designed World (17)

Activity Sheet: Final Paper (C-1)

* The format of final paper (presentation) may be different according to each group's choice. However, students should include the important elements of a scientific paper such as the statement of the problem, the importance of the problem, method used in their study, conclusion, recommendation, etc. when they write a final report.

Team Members:

The problem of study	<ul style="list-style-type: none"> • What are the key questions to investigate? <p style="color: blue;">Which activities (if any) around the coral reefs of Kailua Bay should be restricted to insure their lasting protection?</p>
The Background of study	<ul style="list-style-type: none"> • Why do I need to investigate this problem <ul style="list-style-type: none"> ○ Define my role ○ Relationship between my role and coral reef ○ The importance of coral reefs to my role
Method	<ul style="list-style-type: none"> • Study plan • The process of data collection • The process of data analysis
Results	<p style="color: blue;">Write the results of your investigation.</p>

Recommendation

1.

- There are laws that state that there is a minimum distance within the shoreline which a house can be built (http://www.capitol.hawaii.gov/sessioncurrent/bills/hb2185_.htm). This is to insure that the coastal environment, including the reef, is not adversely affected by the development. So without even looking at the data, the state has already established laws which should insure the health and safety of the coral reefs from additional coastal development.
- If we look at the overall percentage of coral cover, we can see that the range of coral cover essentially stayed the same over the 2 year time period. In case you are wondering about the calculations, they are $(\text{Area fraction of category}) \times (\text{Range of the fraction of living coral}) \times 100 = \text{range of percent of coral cover in that category}$. When we total up all the categories we get a range of the total percentage of coral cover in the entire image.
- Essentially, the total range of coral cover has not changed from 1998 to 2000 so there is nothing really to worry about. In addition, the ranges provided are so big (~20%) that it would be difficult to actually quantify how the reef has changed over this short period. Unfortunately, I don't feel confident using the AVIRIS data because 12% of the image is covered by cloud and cloud shadow (see AVIRIS pie chart). In summary, coastal development on Kailua Bay has not shown any adverse effects on the coral reef ecosystem and continued development within the state laws should be permitted.

2. Alternative Perspective

- Although there is essentially no change in percent coral cover over the two-year period, it doesn't mean that coastal developments have not had an adverse effect on the coral reefs. Two years is not long enough of a period to make any statements about the health of the reefs. In addition, the Landsat ETM+ images have 30-meter spatial resolution compared to the 1-meter spatial resolution of the DMSV images. Due to the poorer spatial resolution of the ETM+ images, areas of coral cover could be overestimated and in reality the reefs could be suffering.

- In a national and global context, coral reefs have been suffering due to the impact of coastal development. “In the U.S. alone, nearly half of all new residential development is near the ocean, and people are moving there at a rate of 3,600 per day.” (http://www.state.gov/www/global/global_issues/coral_reefs/fs-coral_coast_981019.html) The sand and fossil reef areas make up 48% of the study area as determined from the Landsat pie chart. This data is from February 12th, 2000. The pie charts show that the area covered by sand and fossil reef is 44% as determined from the AVIRIS data collected 2 months later on April 12th, 2000. However, this image has clouds and shadows in it that may reduce the accuracy of estimations. The area covered by sand and fossil reef is estimated to be 40% as determined from the Multi-spectral data collected on January 10th, 1998. These results suggest that more area is covered by non-living reef in the year 2000, than in 1998. This means that there is less live reef (algae and coral) in the year 2000 than in 1998.
- In summary, due to the increase in the percentage of sand and fossil reefs over the two-year period coupled with the lack of long-term data on the coral reefs in Kailua Bay and the negative impact that coastal development has had in other regions of the world, it is best to err on the safe side and pass measures preventing additional development on the Kailua coast.

Examples of other recommendations

1. Commercial fisherman:

The commercial fisherman could use basically the same argument as the coastal developer with the final conclusion being: Fishing in Kailua Bay has not shown any detrimental effects on the coral reefs and should continue within the existing state of Hawaii fishing regulations (see: <http://www.state.hi.us/dlnr/dar/regbk/pages/marfish.html>). This web site shows that fish must be minimum size to be caught. This is to insure their successful reproduction, and therefore sustain the fishing industry. One type of popular Hawaiian fish, akule, "seems to be fished in a sustainable manner" according to the following article (<http://starbulletin.com/1999/06/01/news/kokualine.html>). If fishing were banned in Kailua Bay, that could set the stage for the environmentalists to make their case for banning fishing throughout Oahu. Commercial fishing is a multi-million dollar industry in Oahu and banning it would cause tremendous damage to the local economy.

Alternative Perspective: It is better to err on the side of caution and set up regulations to protect the fish population in the Kailua Bay coral reef ecosystem. We are not suggesting an outright ban on fishing, but instead a compromise of seasonal fishing which would insure the long-lasting protection of both the fishing industry and the coral reef ecosystem. In conclusion, to maintain the health of the Kailua Bay coral reef ecosystem, fishing would only be allowed during certain times of the year and permits would be required during the appropriate season.

2. Tourist:

As a tourist to the Hawaiian Islands, snorkeling and scuba diving among the coral reefs is one of the most incredible experiences of my life. The natural beauty and diversity of the reefs is one of the major factors that keeps me coming back to the islands. In addition to aesthetic beauty, the coral reefs bring in millions of dollars in revenue to the Hawaii economy. "In Hawaii, gross revenue from just a single, half-square-mile coral reef reserve was estimated at more than \$8.6 million a year" (Reef-saving effort focuses on Hawaii: <http://starbulletin.com/2000/03/02/news/story8.html>). Based on Table 1 (in the coastal developer section), it is clear that the percentage of coral cover has remained essentially the same over the two-year period from 1998 to 2000. Therefore snorkeling and scuba diving should not be curtailed in Kailua Bay because they have shown no adverse effects on the coral reef ecosystem. Placing restrictions on recreational aquatic activities around the Kailua Bay coral reefs would only serve to hurt the already ailing Hawaii tourist industry.

Alternative Perspective: If we look at classification images and corresponding pie charts, it is clear that the Kailua Bay coral reef has declined over the two-year period from January 1998 to February 2000. Just looking qualitatively at the classification images shows an increase in the amount of sand and fossil reef, which translates into a decrease in coral cover. It is clear that tourism has played a big role in damaging the coral reef ecosystem, especially when divers and snorkelers step on and kill the coral reefs. I propose that we limit the number of tourists that can snorkel or dive in Kailua Bay to insure the long-term health of the coral reefs. While this may hurt the tourist industry in the short-term, it will insure that both the health of the reefs and tourism in Hawaii will continue to flourish for many years to come.

3. Coral reef expert:

Coral reefs are one of the most diverse ecosystems in the world. They serve a multitude of roles from protecting our coastal development from large waves, sustaining our fishing industry, helping our tourist industry, and even providing extracts for pharmaceutical drugs to help find cures to diseases. Although the overall coral cover has remained virtually unchanged over the two year period from 1998 to 2000, this period is not long enough to make any definitive statements about the health of the reefs. Longer-term studies in other regions of the world have shown that coastal development, over fishing, and over-commercialization (too many tourists) have led to the demise of the coral reef ecosystem. If current conditions continue, "an alarming 70 percent of the world's reefs may be gone by 2050," said D. James Baker, task force co-chair and head of the National Oceanic and Atmospheric Administration (Reef-saving effort focuses on Hawaii: <http://starbulletin.com/2000/03/02/news/story8.html>). With the onset of global warming, coral reefs will become more susceptible to bleaching events. This makes it imperative that we pass measures to protect the long-term health of the coral reef ecosystem.

4. Native Hawaiian representative

Coral reefs play an important role in the Hawaiian culture. According to Hawaiian mythology, the coral polyp was the first creature to emerge during the creation story. The scientific data suggest that the percentage of coral cover in Kailua Bay has not changed significantly from 1998 to 2000. Although the Western perspective may be to continue to exploit the coral reefs for their economic value, we Hawaiians feel that it is important to remember the religious value that corals have on our lives. Corals are sometimes even offered during religious ceremonies. The coral reefs are extremely valuable to the Hawaiians and we urge that the coral reef ecosystem be treated with respect. Only take what is needed, not desired.

Sustainable management of the coral reefs is essential if we hope to preserve this asset for the future generations.
http://www.state.gov/www/global/global_issues/coral_reefs/fs-coral_coast_981019.html)

Possible Final Conclusion (C-2)

Write your final paper of one or two pages to be submitted to the Congress, analyzing the problem or situation, and making suggestions about the coral reef problems in Kailua Bay. Support your solutions or decisions with arguments and evidence based on the role you played, and evaluate your solutions or decisions. This time, be sure to write your own conclusion based on your view, rather than taking on the position based on your role.

In our initial mission request letter, we were asked to answer the question, “Which activities (if any) around the coral reefs of Kailua Bay should be restricted to insure their lasting protection?,” within the context of our role and the scientific data available. Given the many stakeholders involved, it was extremely difficult to come to any sort of overarching consensus. However, there are a number of recommendations that we can make in our final report which attempts to take all or most of the parties viewpoints into consideration. It was agreed that we must be able to walk the fine line between economic viability and environmental considerations.

Sustainable tourism

(<http://www.hawaiiecotourism.org/news.sb070301.step.htm>) is something that both the local residents and tourists want to be a part of. That is, “to promote tourism policy in Hawaii which supports beneficial social, cultural and environmental relationships in the tourism development process and facilitates the use of sustainable practices within the existing tourism industry” (http://www.tim.hawaii.edu/step/step_about.htm). This starts with strong educational programs, very similar to the one established in Hanauma Bay (see <http://www.soest.hawaii.edu/SEAGRANT/CRM/CEH2C.html>) directed at the schools and the general public explaining the importance of the reefs in an economic, social, cultural (Native Hawaiian practices), and environmental sense. These programs would stress the relationships between these facets and would emphasize how we all have to do our part in protecting the reef as a community. We feel that all stores that rent and/or sell scuba or snorkeling gear must be required to educate their prospective buyers about the importance of protecting the reef. Coastal developers can continue to develop on the coast as long as they go through stringent environmental controls and assessments to make sure they do not cause any adverse effects to the coral reefs. Any violation will result in stiff penalties and a revoking of the building license. Commercial fisherman may continue their practices under the current regulations, but each will be required to get a permit and they must report the details of their catch to the proper authorities.

The two-year comparison between the Landsat and DMSV images are a good starting point for coral reef monitoring in Kailua Bay, but this should

only be the beginning. Longer-term airborne, satellite, and ground truth monitoring of Kailua Bay is necessary to insure the long-lasting health of the coral reef ecosystem.