NOAA Education Mini Grant Progress Report

NOAA PI	Sidney Thurston
NOAA Office	Climate Program Office
NOAA Partners	None
Outside Partners	AAAS Project 2061
Project Title	Developing a framework for climate & weather education: Building from AAAS Project 2061's Atlas of Climate & Weather Science Literacy
Award #s	D8P1EP (Direct Cite) D8P1EAA
Award Amount	$52,270
Start Date	4/27/06
Type of Report	6 month ☐ Final ☒
Project Progress	The project was completed on April 13th, 2007. Susan Lynds, CIRES, completed the evaluation report on 5/7/07. The evaluation report file is titled "AAAS-NOAA-Cli_Lit-Report-final.doc."

Budget Update	Accomplishment/Milestone/Task	Amount Spent	Date Completed Month/Year
	OAR CPO Education Milestone FY 06- Develop climate literacy key concepts prototype based ocean literacy key concepts	$52,270	April 13, 2007

Issues/Concerns	As part of the next steps for the NOAA climate literacy effort, NOAA CPO will transfer funds for one month of salary including benefits for CIRES Associate Scientist Mark McCaffrey with CIRES Outreach, who attended the workshop, to assist in synthesizing and refining the recommendations from the workshop with a small team of other participants. The specific outcome of this work will be a draft framework organized in an easily accessible manner that will serve as the working document for a follow-up workshop planned for November, 2007, to be funded by NSF, that will build on the initial framework and be reviewed by the broad climate community.

Framework for Climate & Weather Education Workshop: Using The Atlas Of Science Literacy To Develop Weather And Climate Literacy (AAAS—Project 2061)

April 11-13, 2007

Washington, D.C.

Evaluation Report

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May 3, 2007

Table of Contents

Executive Summary

The Framework for Climate & Weather Education Workshop was successful in achieving its overall goals. Participation levels were high throughout all three days and enthusiasm extended into the formation of a core group willing to carry the project into the future.

Workshop Framework

Selection of the AAAS Project 2061 Atlas Workshop as the general framework for this workshop was moderately effective. All participants were familiar with Project 2061 and were willing to work with the benchmarks as key components of the agenda. Participants found their use of the Atlases of Science Literacy to be especially effective. The standard AAAS Atlas Workshop design was modified so that it would introduce use of the Atlases in the context of developing a climate literacy framework. This concept worked well overall, but was further modified to meet the priorities of the group--at the end of the first day, attendees were anxious to begin work on the outcomes of the workshop (i.e., developing the fundamental climate literacy principles). The facilitators modified the schedule by cutting some of the more detailed exercises dealing with the Curriculum Analysis Procedure and the Assessment Analysis Procedure; these changes allowed more time to work on the outcomes.

Goals and Objectives

Original workshop objectives were designated in the context of the preliminary agenda and many of them were achieved in full. Partially achieved objectives were less relevant to the goals due to changes in the structure of the workshop after the first day.

Evaluation Protocol

There was a slight mismatch between the final evaluation instrument and the actual happenings at the workshop due to the agenda modifications. This could have been prevented by a re-write of the final survey instrument the evening of the second day. Continuous observation of the full workshop enhanced the evaluation project, as did collection of the flipchart and worksheet data as documentation of participation.

Logistics

Logistics were good overall. The meeting facility had limited cell coverage and no wireless. The lack of internet access was reported as a problem by two participants. Food was provided on site; this was effective because leaving the facility for meals would have raised security issues. Group sessions were around a rectangular table with roughly nine chairs down each side and four at the end. The projection screen was adequate, though a little small and low. Windows did not have shades; which was only a difficulty briefly on the first day. There was ample room for breakout groups, although the secondary room had some temperature issues (an irregular thermostat and a noisy fan).

Future Plans

An enthusiastic core group agreed to continue to pursue developing the envisioned climate literacy product after the end of the workshop. The possibility of a follow-up workshop in the fall, possibly in Boulder, was brought up and seemed to be acceptable. The development of the fundamental climate principles will be continued via online resources, email, and other contacts over the summer.

Recommendations

- Group discussions and breakout groups were widely regarded as very effective at this workshop. Networking with other participants was also highly valued by attendees.

- Future workshops for this project should emphasize specific outcomes to potential participants to give a better idea of the workshop purpose. This may encourage broader participation, both in terms of organizational variety and geographic representation.

- Initial plans to keep the workshop very similar to the AAAS Atlas Workshop may have been a barrier to communicating the full intent of the workshop. There was confusion among attendees on the first day regarding the outcomes from the workshop. One participant said the original workshop description may have been interpreted as being a "Benchmarks 101" class instead of a climate literacy development project.

- Goals, objectives, and outcomes of future workshops should be presented and discussed very clearly at the beginning of the first day; this may enable any necessary reworking of the agenda to take place early in the process.

- It is hoped that broader participation will be recruited for future work on this project. There will be a concerted effort to involve members from other agencies and non-governmental organizations. As a comparison, it was reported that 80 different people from over a dozen organizations worked on the Ocean Literacy brochure.

- Based on replies to the final survey, homework tasks may not be a productive use of attendees' time; whether that is a characteristic of the particular homework tasks of this workshop or workshops in general is unclear.

- Participation levels were good throughout the workshop. All attendees stayed on task fairly well and seemed comfortable contributing to discussions. Breaking out the groups in different ways so that everyone eventually worked with everyone else seems to have been effective.

- At future meetings, if the agenda is modified significantly, a re-write of any remaining survey instruments may be appropriate.

Introduction

This workshop was a result of a FY 06 NOAA (National Oceanic and Atmospheric Administration) Education Mini Grant. The purpose of this project was the development of a workshop as a catalyzing event to focus on the building of a framework for climate and weather literacy. The workshop was to bring together various federal agencies and other organizations including formal and informal educators, non-governmental organizations, and other appropriate institutions to work together towards this goal.

Frank Niepold, NOAA Climate Education Coordinator, was the moderator of the workshop. The facilitator was Ted Willard, who runs the AAAS Project 2061 Atlas workshops.

The American Association for the Advancement of Science (AAAS) Project 2061 has developed a draft "Weather & Climate" strand map; they provided the facilitation for this workshop as well as materials (publications for all attendees including Science for All Americans, Benchmarks for Science Literacy, and the Atlas for Science Literacy, Volumes 1 and 2).

The prospect of developing the key concepts for climate literacy was inspired in part by the Ocean Literacy project, which has produced a brochure (http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf). The brochure was discussed during the present workshop as a model of a possible outcome for the group to work towards. The Ocean Literacy publication includes essential principles, fundamental concepts, and an associated listing of science education standards.

Willard and Niepold explained that this event is a modification of the general 2061 Atlas workshops. Changes made to the standard format included the following:

- the content area used was different
- day three items have been moved to day two
- some sections have been removed to make room for content specific information (for example, in the traditional workshop they do an instructional activity which is not included here)

At the end of the first day of the workshop, the original agenda (see Appendix II) was modified to accommodate the enthusiasm of attendees to direct more workshop time to the development of the outcomes.

Evaluation Procedures: Data Gathered and Analytical Methods

The evaluation of this workshop was developed to assess the successfulness of the workshop's goals and objectives. Two questionnaires were administered (see Appendix I)--one at registration and one when attendees left on their last day. Observation of the workshop provided documentation of the proceedings for evaluation, as did recording of flip-chart notes and worksheets from breakout groups. Questionnaires were anonymous.

Elements of the evaluation protocol were designed to probe how well each objective was achieved as shown in the Table of Methods (Table 1).

Table 1. Table of Methods for workshop evaluation.

Workshop Goals	Specific Objectives	Agenda	Evaluation Data	Qualitative Evaluation
Participants will understand how to use the Project 2061 Goals Documents (Science for All Americans, Benchmarks for Science Literacy, and Atlas of Science Literacy) in their educational work as it relates to weather and climate literacy.	An overview of Project 2061 will be presented, followed by an open discussion.	Full Session Day One 9:15am	Observation; review of record (flipchart, etc.), pre- and post-workshop surveys	Obervation of Discussions--Day One 3pm and Day Two 8:30am
	Participants will write learning goals for several grade ranges, consider the nature and usefulness of learning goals, and question how they develop in sophistication through the grades.	Breakout Session Day One 10:15am	Review of records (flipcharts, etc.) from breakouts	Obervation of Discussions--Day One 3pm, Day Two 8:30am, Day Three 8:45am
	Participants will review a set of curriculum development resources targeting a particular benchmark	Breakout Session Day One 1pm	Review of records (flipcharts, etc.) from breakouts	Obervation of Discussions--Day One 3pm and Day Two 8:30am
Participants will understand the Project 2061 Curriculum Analysis Procedure to increase their ability to select or develop curriculum materials that promote student learning as it relates to weather and climate literacy.	Participants will review particular criteria in Project 2061's Curriculum Analysis Procedure	Breakout Session Day Two 9:30am, Full Session 10:30am	Review of records (flipcharts, etc.) from breakouts	Observation of Discussions--Day Two 3pm and Day Three 8:30am

Table 1 (cont.). Table of Methods for workshop evaluation.

Workshop Goals	Specific Objectives	Agenda	Evaluation Data	Qualitative Evaluation
Participants will understand the Project 2061 Assessment Analysis Procedure to increase their ability to select or develop assessment tasks that actually probe for student understanding as it relates to weather and climate literacy.	Participants will examine two assessment tasks using the Project 2061 process for analyzing an assessment.	Breakout Session Day Two 1pm	Review of records (flipcharts, etc.) from breakouts	Observation of Discussions--Day Two 3pm and Day Three 8:30am
Participants will understand techniques for unburdening the curriculum to provide more time to focus on the most essential knowledge and skills in weather and climate science literacy.	Participants will review a procedure for removing parts of the curriculum that do not contribute to science literacy.	Full Session Day Two 11am	Observation; review of record (flipchart, etc.)	Observation of Discussions--Day Two 3pm and Day Three 8:30am
Participants will establish a framework of how educational programs and developers can create climate and weather lessons using the AAAS Project 2061 research and products as it relates to weather and climate literacy.	Participants will identify benchmarks across multiple Atlas maps that are likely candidates for inclusion in the Weather and Climate Literacy fundamental concepts and essential principles document.	Breakout Groups Day Two 2pm and Day Three 1pm	Review of records (flipcharts, etc.) from breakouts	Observation of Discussions--Day Two 3pm and Day Three 8:30am & 2pm
	Participants will select from all the selected benchmarks the top ten and the 6-8 categories for fundamental concepts and essential principles document.	Breakout Groups Day Two 3:30pm and Day 3 10:30am, 1pm, 2pm	Review of records (flipcharts, etc.) from breakouts	Observation of Discussions--Day Two 3pm, Day Three 8:30am, 10:30am & 3pm

Registration Survey

When attendees arrived, they were asked to complete the registration survey (see Appendix I). This instrument collected information on their professional role, organization, location, familiarity with Benchmarks, and their goals for the workshop. A few participants arrived later (on the first or second day). A total of 21 registration surveys were collected. Response rate was 100% for those attending more than one day. A few folks came and left after only a few hours; most of these were associated with either Project 2061 or the hosting NOAA office.

More than half the attendees at the workshop were NOAA employees from the eastern United States. Throughout the workshop, the consensus was that representatives from other organizations (government and non-government) should be recruited to participate in the climate literacy project. A number of people from other organizations had expressed interest in the workshop, but were unable to come at this time.

Two attendees were high school science teachers as well as being currently Einstein Fellows with NOAA in DC. Another participant was an environmental science teacher. Thirteen respondents said their professional roles were within the fields of education, outreach, and communications as specialists, directors, managers, coordinators, and liaisons. One attendee was a policy analyst and one was a scientist. Two were higher education instructors. Later in the workshop, seven participants indicated that they were either current or former K12 teachers.

More than half the attendees were with NOAA (see Table 2). States represented were almost all from the eastern United States (see Table 3).

Table 2. Attendee organizations reported on the registration survey.

Agency	Count
NOAA	12
NASA	2
Others	7

Table 3. States represented at the workshop.

State	Count
CO	1
CT	1
DC	4
DE	1
FL	1
MA	1
MD	10
NC	1
VA	1

Most attendees reported that they were at least somewhat familiar with Project 2061 (see Table 4).

Table 4. Attendees' familiarity with Project 2061.

How familiar are you with the AAAS Project 2061?				
Response	Not at all familiar	Have heard it mentioned	Somewhat familiar	Very familiar
Count	0	1	13	6

All participants had used science literacy goals and benchmarks in their work (see Table 5). Ten respondents had participated in past benchmark and literacy development projects. One said they had used literacy goals to "structure the development and evaluation of an agency-wide education program."

Table 5. Attendees' use of goals and benchmarks.

How much have you worked with science literacy goals and benchmarks?					
Response	I use literacy goals and benchmarks in my outreach work	I have worked on literacy goal and benchmark development	I work with educators using literacy goals and benchmarks	I use literacy goals and benchmarks in my communications projects	I have not used literacy goals or benchmarks in my work.
Count	11	10	14	6	0

Participants were asked what their main reasons were for attending the workshop. Responses fell into four main categories as follows:

- general interest
- to participate in the decision-making process for literacy standards
- to explore practical application of literacy standards
- to represent their organization or group at the workshop

Four respondents cited their interest in the topic as their main reason for attending. One of these indicated an interest "in learning more about integrating benchmarks and strand maps to better communicate concepts of climate change, environmental and ocean literacy."

Seven participants explained the work they hoped to do at the workshop towards establishing climate literacy goals. They were anticipating contributing to the decision-making process and discussions.

Four respondents explained how their attendance at the workshop would interface with their professional activities. Two described their hope to incorporate climate literacy goals and benchmarks into the projects at their organizations. Two were focused on enabling educators to incorporate the new standards into the classroom.

Four attendees said their main reason for attending was to represent their organization, to share information about their institution's activities, and to present the perspective of their colleagues.

Workshop Observation

Day One

Workshop participants received a workbook with an updated agenda (see Appendix II) as well as handout and worksheet information. They also received copies of the AAAS Project 2061 publications (Benchmarks, Atlas 1 and 2, and Science for All Americans).

The first session of the first day began with Willard presenting questions to the participants in order to generate discussion:

- What is one thing you think is positive about standards movement?
- What is one thing you think is challenging
- What attracted you to this workshop?
- What do you expect to get out of this workshop?

During the ensuing discussion, all 18 attendees participated at one time or another. Among the topics discussed were the differences between public and private schools; public have to teach to tests whereas private schools have more choice in their curricula. One secondary instructor noted that the students he receives are well-prepared in weather but not in climate. The problem that earth sciences are not accepted as a viable science credit by schools was discussed briefly.

The importance and visibility of climate education was then discussed, including the social dimensions, the integration of key elements of other sciences in climate topics (e.g., chemistry, physics), and the role of weather education in the climate context.

Niepold broached the question to the group, "What is a climate literate person?" The goals for the workshop were then discussed: begin the process of establishing the essential principles and fundamental concepts for climate literacy. This has recently been done for Ocean Literacy. Niepold asked everyone to make notes during the workshop of fundamental climate concepts they would like to see included in the outcomes of the workshop; these will be discussed later in the agenda.

Willard then presented two videos of students (elementary and college) who shared their ideas of the development of a section of a tree (a log); the students demonstrated a variety of conceptual understanding. The task for this exercise was to become familiar with the AAAS publications by finding the associated concepts in the Atlas.

There was a slight logistics problem during the videos because in order to get the room dark enough to see the videos (with the unshaded windows), all lights were turned off. This made it a bit dark at the tables for participants to read or mark any concepts in the publications.

Discussion followed about the videos' documentation of a lack of understanding of photosynthesis. Willard pointed out that each benchmark may be only taught for a few

days in a student's life; if the string of understanding is not carried forward into future learning, it will be lost. The concept of enduring ideas that students will remember their whole life was mentioned, as well as how important it is to have basic concepts very solidly in place before more complex ideas are brought into the curriculum.

Willard then reviewed the history of Project 2061, Science for All Americans, the Benchmarks, and the Atlases. Definitions of science literacy and the inclusion criteria for Science for All Americans were provided in the workshop notebook; attendees were given time to review this. Discussion followed with regard to how to use the Atlases and Benchmark codes, as well as how these materials have been used in the context of No Child Left Behind and who is using them.

There was good attentiveness by workshop participants throughout this lecture and discussion section of the agenda. There was a break at this point in the schedule.

After the break, participants were randomly divided into four breakout groups to write a learning goal on the water cycle. The groups were to address the needs of grades K-2, 3-5, 6-8, and 9-12, and record the learning goal on a flipchart. Pages 13 through 18 in the workbook applied to this activity.

Two groups (K-2 and 3-5) had five people each; the other two groups had four. Groups were all actively conversing, though later in the period two of the groups had divided in half (two discussions going on). Initially, one person each in two of the groups was reading the materials and not participating in the discussion; they later joined in the conversation.

There was good participation in all four groups. Much discussion concerned what specific words to use and what was appropriate for each grade range (both for teachers and for students). Some participants were hesitant because they had been assigned to a group dealing with an age group with whom they weren't familiar.

The moderators circulated among the breakout groups to facilitate the work. When tasks were completed, the group reassembled to discuss their goals. Flipchart notes from each group are seen in Figures 1-4.

K2 Group; group 1
1. Water is made of smaller parts that never disappear; they just change their form, depending on their temp.

2. Water can exist in 3 forms, solid, liquid, gas; depending on temperature. Water moves through air as clouds or fog (in the atmosphere) and on the land as oceans, lakes and rivers, changing form in the process.

2 final. Water moves through the air as clouds, fog, rain, on the land as rivers, lakes, ocean and can exist in three forms; solid, liquid, gas.

3. Can observe water in its forms (clouds, rain, ice)

4. Students will experience curiosity about water (e.g., water as invisible gas)
Smaller parts can exist as solid, liquid, or gas.

Figure 1. K-2 Breakout group--learning goal for the water cycle.

Group 2 Grades 3-5 Ages 8-10
Preliminary page:
Cycle
Where do you find water?
Exists in three phases?
Understanding of phases—liquid, solid, gas
Change is caused by heat (temperature)
Change back and forth
Explain process

Final:
Water is found in nature in three forms. Liquid, Solid (ice), and invisible gas. Any form can change from one to the other as heat is added or taken away.

Figure 2. 3-5 Breakout group--learning goal for the water cycle.

Group 3 Middle School

Students need to understand:
A large % of the earth surface is water
Water changes form
Water cycle is driven by seasonal cycles (temp/energy/light/heat)
Evaporation/condensation
Water physical states
Natural processes like the annual cycle and human impacts can alter the water cycle.
Need temporal/variability concepts included.

Final:
Natural processes (such as variability in the annual cycle) and human impacts (such as greenhouse gases, land uses) alter the water cycle.

Figure 3. K6-8 Breakout group--learning goal for the water cycle.

Group 4—High School
Contributing:
Water can be a solid, liquid, or gas.
Water has unique properties (of ice, universal solvent, etc.)

Conservation of matter (evap, cond, precip)
Earth is a "water planet" (H2O in all 3 states)

Final:
Water molecules undergo changes of state through addition or subtraction of thermal energy, but there is a conservation of matter.

Figure 4. 9-12 Breakout group--learning goal for the water cycle.

In the general discussion of the K-2 learning goals, members of that group were concerned about keeping things at the right level and how to prevent misconceptions from developing (e.g., water disappears when it becomes a gas). Many were worried about the wording of learning goals, but others pointed out that the language in the goal doesn't necessarily impact the way it's taught. Willard added that, alternatively, the goal can indicate the best terminology to use at a particular grade range.

Willard presented the following questions about learning goals:

- does the goal provide a reasonable step along the way towards SFAA statement?
- is the goal clear and specific?
- do you think a teacher reading this goal would understand what was expected?
- are there differences between the goals in different grade ranges?
- how do the goals relate to one another?

Following these questions, the sample water cycle learning activity in the workbook was discussed. Willard guided discussion around two additional questions:

- What is the best level of complexity for different grade levels or the general public?
- What is the least sophisticated version of a lesson that we can get away with and still be effective?

After lunch, Willard introduced the Curriculum Analysis Procedure. The group was then broken into seven groups to address each of the seven instructional criteria on page 20 of the workbook, filling in the worksheet on page 23 entitled "Understanding the Criteria." Five breakout groups had two members; two had three. Each group answered three questions on their worksheet:

1. What is the main idea of this Criterion?
2. What features might a curriculum material need to have to meet this criterion?
3. Why might curriculum materials that meet the Criterion be more effective than materials that do not?

Figures 5-10 are the responses from the breakout groups to the three questions, based on the criterion they were assigned. Note that there is not a Criterion 6 group due to their worksheet not being collected. There are also two Criterion 7 worksheets, based on different people's notes.

Criterion 1
1. Follow a string of learning from past to present including ancillary activities leading to definition of final goals.

2.
1) Basis of link knowledge
2) Application of principles applied
3) Education outcomes

3. Because they meet the effective criteria better than those that don't enhance student engagement and enforcing learning principles.

Figure 5. Criterion 1 group worksheet.

Criterion 2
1) Experiences in a variety of contexts. First hand and vicarious experiences to confront, explain, test their ideas about phenomena.
2) Plenty of opportunities to work firsthand with constructing and using scientific ideas.
Access to natural world, even through modeling.
3) Otherwise ideas are too abstract and not real or connected to their world.

Figure 6. Criterion 2 group worksheet.

Criterion 3
1) Assure not just abstract but relate to everyday world. Stimulate inquiry/wonder.
2) Access to natural world; even through modeling in classroom.
3) Remain abstract and not connect to their world.

Figure 7. Criterion 3 group worksheet.

Criterion 4
1) Concepts exemplified EVIDENCE >> Strengthened by student experience where possible. Is the concept represented by real world examples that students can experience firsthand "ideally" and apply these examples in a variety of different contexts.
2) Credible evidence presented to single concept. A variety of experiences to demonstrate that concept >> several prescribed, several developed independently by students.
3) Multiple experiences across scientific disciplines, opportunity for students to demonstrate their skills, demonstration of concepts in their day to day lives.

Figure 8. Criterion 4 group worksheet.

Criterion 5

1) Allow student individual explanations/interpretations and reflections on their learning.
Judging student understanding and integration of concepts.
2) Individual feedback/understandings.
Verbalize/write/multiple means of communicating
Time
3) Learning thru constructivist process
Each student has different learning and experiences/filters in their gaining of knowledge.

Added V.C. Encouraging students to think about what they have learned.

Figure 9. Criterion 5 group worksheet.

Criterion 7 number one

1) Teachers need to be provided with correct, in-depth content background.
Students—classroom needs to be intellectually open and have an inviting atmosphere.

2) Content background for teacher that goes beyond what is going to be taught. (Must be scientifically accurate)
FAQs and/or FEMs (Frequently encountered misconceptions) with correct explanations and suggestions for overcoming misconceptions.
Ideas for differentiation
Examples of multi-cultural people in or doing the curriculum.

3) Teachers feel more confident in teaching curriculum
Teachers who do not have extensive background knowledge of the content in the curriculum, suggestions for overcoming misconceptions will help them.
Differentiation suggestions will help teachers to do a better job of meeting the needs of all their students.
Students (and teachers) of different cultures, races, and disabilities will have examples to encourage them.

Criterion 7 number two

1) Maximizing the learning environment through building teachers confidence in their content understanding and students'confidence in their abilities to do science.

2)
7A Teacher background; student answers; student misconceptions explained; online resources.
7B Inquiry strategies and teacher advice on flagging these.
7C Illustrations, extensions, alternate routes, alternate assessments

3)An atmosphere in which a teacher lacks content understanding and students are afraid to learn is not one that lends itself to effective science inquiry.

Figure 10. Two Criterion 7 group worksheets.

The criteria were reviewed briefly by each group. After this, a general discussion broke out about the purpose of the workshop and its outcomes. The Ocean Literacy brochure was addressed to all audiences (K12, informal, outreach, etc.). Niepold clarified that the goal for this workshop was to produce about seven key principles about climate literacy, similar in form to the seven listed on the Ocean Literacy brochure.

There was some discussion about how the Ocean Literacy group went about creating their publication. Using their process as a preliminary model may help the current group achieve the outcomes more quickly than the decade it took the Ocean group to produce their brochure. Two participants commented on how quickly and well the Ocean Literacy brochure is being adopted and used by teachers and districts.

Niepold explained that going through the 2061 exercises was to familiarize participants with the process of using these documents to give a starting point for creating the outcomes.

Participants brought up various points about needing the earth systems link and/or the ocean link with any weather and climate publication. A point was brought up that in the Ocean Literacy project, it was not just about the brochure, but also included a major conference, a study of what the states were doing, and research into the integration with the earth science curriculum.

Niepold clarified that the initial audience for the outcomes of this workshop would be K12 teachers and curriculum developers. He acknowledged that in-service and pre-service training for teachers would be a part of the effort. Using some of the process done by the Ocean Literacy effort or the techniques from Project 2061 may help this group achieve their goals efficiently. Willard mentioned that there is a large overlap between the National Science Education Standards and the Benchmarks. Some of the differences between the two documents were discussed.

The need for additional partners, some non-governmental, in this effort was brought up. It was generally agreed that a single agency should not lead the effort. Federal agencies can offer expertise, but systemic reform is not their business. Other possible partners include TERC, EPA, the Communications Interagency Working Group, DOE, the Department of State, and AMS.

Day Two

Fourteen people were in attendance the morning of the second day, two of them new.

In response to the general consensus from the first day that workshop participants wanted to get moving on developing the outcomes as soon as possible, Niepold proposed modifying the agenda. The group would begin immediately on identifying benchmarks across multiple Atlas maps that are likely candidates for inclusion in the weather and climate literacy fundamental concepts and essential principles document. Remaining assessment and curriculum exercises will be postponed until later.

Breakout groups were self-selected to address on the following five Atlas maps:

- Interdependence of Life
- Common Themes
- Nature of Science
- Earth's Resources and Energy Resources
- Nature of Technology

The groups formed and began work. Some immediately began discussing issues, while others settled down to read the map pages first, most taking notes as they did this. Participation levels were good. Facilitators circulated to assist where needed. Groups provided either flipcharts or sheets of paper with their results (see Figures 11-15). Some groups specified the codes for the benchmarks, while others summarized with text.

Interdependence of Life Flipchart

5D/E4
5F/M2b
4C/M7
3C/H4
5D/H3

Diversity of Life
5A/H1b

Global Interdependence
7G/H4
7G/M5

Patterns of Change
11C/H6
11C/M7
11C/M10

Public Perception of Science
1C/H6ab

Flow of Energy in Ecosystems
5A/M5

Flow of Matter in Ecosystems
4C/H1

Figure 11. Independence of Life group—related benchmarks.

Common Themes Group Flipchart

CONSTANCY
*11C/H1**
*11C/M3**
*11C/M2**
*11C/M11***
*11C/P1**

Patterns of Change

11C/H7b
11C/H7a
*11C/H6**
*11C/H8***
*11C/H9***
*11C/H5**
11C/H4
*11C/M9***
*11C/M7***
*9C/M4**
*11C/M10***
*11C/M8***
*11C/M6**
11C/M4
*11C/E3***
*11C/E4***
11C/E2b
11C/E2a
*9C/E3**
*11C/P1**
*11C/P4**
*11C/P3b**
*11C/P3a**
11C/P2

Scale
*9C/H6**????*
*11D/M3**
*4D/E6***
11D/P1

Figure 12. Common Themes group—related benchmarks.

Nature of Science Flipchart

1C/E2
1C/E4
1C/M8
1C/H5b
1C/H6
1C/H7
1C/H8
1C/H9
1C/H10
1C/H11
3C/M7
1A
1B Scientfic Inquiry
9E Reasoning
12E Critical Response Skills

---column two---

Creativity 1C/2, 1B/1
Use of Models – 1B/3
Process 1A/2, 1B/6, 1D/7, 1A/3
Investigation 1B/2, 1A/1, ???, 1B/?, 1C/7
Misconception 12D/2, 12E/6, 12E/?, 1D/4

Figure 13. Nature of Science group—related benchmarks.

Energy and Earth's Resources Flipchart

Human Activities
Use—renewables
--conservation
--appropriate technology

ENERGY MONITORING
Misuse—Release CO2 from
BURIED SOLAR ENERGY/photosynthesis
Oceans (>>O2) + Atmos as carbon sink + Bios

Temporal Scaling and Variability
>>Orbital cyclels ENSO
>>Solar Radiation
Insolation
Transfer
..Solar energy is primary driver of
..photosynthesis >> buried solar energy
..renewables
..water cycle
..carbon cycle
..annual cycle
oceans >>weather and climate

Earth Use of Resources Page 23; Energy Resources Pg 59
5D/H3 + H1
3C/H4
*8B/H7,4,8***
*8C/H5,H4,M10**,M6,M1,M11,H8**,H3*
4C/M9
*4B/M8**
Non Renewable
Industrial Usage/misusage
Human Activites

Figure 14. Energy and Earth's Resources group—related benchmarks.

Nature of Technology Flipchart

A global network of satellites, ground-based sensors and human observers provide essential data about weather and climate.

Data analysis and visualization tools help scientists understand and communicate weather and climate processes.

Internet enables scientists to readily access rich sources of data and share their research with others.

Internet, television and other communication tools enable the general public to access the same rich data sources as the scientists.

Scientists use climate models to make weather and climate projections. These models are approximate representations of real systems and their accuracy improves with new observations, insights, and technologies.

As we consider historical data, we need to understand the level of technology available at the time of the observations and analysis.

Figure 15. Nature of Technology group—related benchmarks.

The group discussion after the breakouts again focused on the national attitudes, agency perspectives, white house attitudes, and organizational participation in the climate literacy effort. Then, each group presented their findings on the breakout task.

The Interdependence of Life group looked at human activities, changing environmental conditions, human impact on other species, and interactions. They focused on interactions between organizations and global interdependence, which is affected by policies and practices. There is a growing interdependence. There will be some beneficial effects to some organisms with climate change; others will be harmful.

The Common Themes group noted that they forgot to put models on their chart, although they did find a group of them. They looked at patterns of change, equilibrium issues, constancy, and scale issues.

The Nature of Science group included general themes such as creativity and communication. They also looked at the use of models—what they are and how to apply them to problems. In addition, they referenced theory processes and thought processes, including the scientific method and misconceptions. A lot of what was underscored was the idea that the scientific enterprise is influenced by society (politics, social, etc.).

The Energy and Earth's Resources group focused on temporal scaling and timescale processes, which they couldn't find in the benchmarks. They were careful to differentiate between weather and climate forecasts. Mentioned specifically were solar energy, fossil fuels (as buried solar energy), and the use of resources.

The Nature of Technology group found that benchmarks related to their topic were not worded in a way that applies to weather and climate. Instead of citing benchmarks, they provided a fundamental concept list of five key ideas.

Willard made the point that one main issue for achieving science learning goals is time available to the teachers—some think that the number of benchmarks and standards need to be cut in half.

Niepold added that incorporation of elements of Project 2061 will enable the work to leverage their strengths.

The workshop then broke into groups to list between three and five main themes for a climate literate public. These were turned in to Willard for coordination at end of the day; they would be discussed on the final day.

Day Three

Between 16 and 18 participants were present at different times on this day.

The suggested principles had been transcribed overnight and were handed out to attendees. They were also taped to the wall in general groupings of theme.

Out of the discussion of the principles, eleven essential principles emerged. The next breakouts were to refine these principles and identify the associated benchmarks. Four breakout groups divided these principles up as follows:

Group 1 Topics

- Climate and weather are related but distinctly different processes
- Climate system is?
- Weather?
- Climate is a complex system that naturally varies over time and place and depends on...

Group 2 Topics

- There has been significant climate change in recent decades substantially due to human influences, which is projected to continue into the future.
- The extent of climate change may differ from one region to another.
- Decisions people make today can affect the climate in the future.

Group 3 Topics

- Life on Earth is dependent on climate.
- Extreme weather events, both short and long term, affect life on Earth.

Group 4 Topics

- Global climate and weather predictions rely on a variety of data.
- How do we know? Scientific investigations and consensus development.

The resulting lists, transcribed later by Willard, are included in Figures 16-19.

WHAT IS CLIMATE AND WEATHER?

I. 1. Climate and weather are related but distinctly different processes

A. 4B/E3 - evaporation

B. 4B/H3 - earth's rotation and axis tilt

C. 4B/H2 -winds and currents (energy transfer)

D. 4B/M7

E. 4B/M9

F. 4B/M12

G. 4B/M13

II. 2. Climate System ...(The earth is mostly rock. Three fourths of the earth's surface is covered by a relatively thin layer of water (some of it frozen), and the entire planet is surrounded by a relatively thin layer of air.)

A. 4B/H3

B. 4B/H5

C. 4B/M9

D. 4B/M2

E. 4B/M12

F. 4B/M13

G. 4B/M14 Climate is defined by average temp, prec., …

H. 4C/M7

I. 4D/E6

J. 4E/M2

K. 4E/P1

L. 8C/H8

M. 8C/M1

N. 8C/M5

III. 3. Climate is a complex system that naturally varies over time and place, and depends on... (

A. 1B/H3

B. 1B/M2

C. 4B/H5

D. 4B/H6

E. 4B/M6

F. 4B/M9

G. 4B/M13

IV. 11. Weather is ...

A. 4B/E3 -evaporation

B. 4B/E4

C. 4B/E5

D. 4B/H2 -winds and currents (energy transfer)

E. 4B/H3 - Earth's rotation and axis tilt

F. 4B/M7

G. 4B/M12

H. 4B/P1

I. 4E/P1

Figure 16. Group 1--themes and benchmarks.

Benchmarks Related To Human Influences, Decisions, And Future Climate Change

4. There has been significant climate change in recent decades substantially due to human influences, which is projected to continue into the future.

3A/H3a
technology usually affects society more directly than science because it solves practical problems and serves human needs
4B/H4
when greenhouse gases increase, more thermal energy is trapped in the atmosphere, and the temperature of the earth increases the light energy radiated into space until it again equals the light energy absorbed from the sun
4B/H6
the burning of fossil fuels in the last century has increased the amount of greenhouse gases in the atmosphere, which has contributed to earth's warming
4C/M7
human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere
5D/H3
human beings can deliberately or inadvertently alter the equilibrium in ecosystems
8C/H4
industrialization brings an increased demand for and use of energy
8C/M11
by burning fossil fuels, people are releasing large amounts of CO2 into the atmosphere
8C/P2
people burn fuels such as wood, oil, coal, or natural gas for electricity

8. Decisions people make today can affect the climate in the future.

1A/M4c
scientists can sometimes be used to inform ethical decisions by identifying the likely consequences of particular actions
3C/M7
societies influence what aspects of technology are developed and how these are used
3C/H4
the human species has a major impact on other species in many ways
4B/H6
the burning of fossil fuels in the last century has increased the amount of greenhouse gases in the atmosphere, which has contributed to earth's warming
4C/M7
human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere
7G/M5
the global environment is effected by national and international policies and practices relating to energy use
8C/H5
decisions to slow the depletion of energy resources can be made at many levels
8C/E4
some people try to reduce the amount of fuels they use in order to conserve resources, reduce pollution, or save money

9. The extent of climate change may differ from one region to another.

7G/H4
the growing worldwide interdependence of social, economic, and ecological systems means that changes in one place in the world may have effects in any other place

Figure 17. Group 2--themes and benchmarks.

Life on Earth is dependent on climate.
Extreme weather events, both short and long term affect on life on Earth.

4B/H1 ***Life is adapted to conditions on earth***
4C/H1

5D/E4	*Changes in org. hapitat are*
5D/H2	*Changes in climate are sometimes beneficial*
5D/M1b	*Growth*
5F/M2b	
5D/M4	

Figure 18. Group 3--themes and benchmarks.

Grouping & Condensing Benchmarks (Group 4)

Q7: Global climate & weather predictions rely on a variety of data.

Scientists make firsthand observations of the world. 11C/P1, 11C/P2

Scientists use tools to collect data (1B/P2)
Remote sensing (e.g., satellites) and in situ (e.g., thermometers) technologies are used by scientists to observe and measure climate & weather phenomena & processes (3A/E2; 3A/P1; & 3A/M2)
Because there are gaps in the data, models are used to simulate climate & weather to help scientists understand & predict the future (11B/M4 & 11B/H4)

Both weather and climate are always changing and can be described by measurable quantities, such as temperature, humidity, and precipitation (4B/E5; 4B/M14; 4D/E6; 11C/all inclusive; 11D/M3; and 11D/P1)

There are margins of error and uncertainty in every measurement scientists make that are understood and accounted for. 12C/E3

Q10: How do we know what we know about weather & climate? (Scientific investigations, scientific theory and consensus.)

Scientists use agreed-upon methods to study weather and climate (1A/H2-1C/H7; 11C/P2; 11C/P3b; 11C/P4)
There are established methods for validating data.

Scientists collect empirical data sets and reproducible observations; for example: (4D/E6; 11E/P2, 11C/P3a; 11D/M3; 11D/P1; 12A/P1; 12C/E3)

Paleoclimatological data that contribute to our understanding of climate change.
Remote sensing data help scientists to understand weather and climate now and in the recent past.

Scientific findings are peer-reviewed. (12A/H3; 12D/P2)

New hypotheses and/or theories are in logical alignment with previous theories (12D/E1; 12E/E3; 12E/H4).

Dodgy Items

Scientific consensus on a topic, such as climate change, can affect societal decisions and behaviors.(?)
Societal, economic, religious and political influences can affect the public's acceptance of scientific information on a topic (such as the causes of climate change).
Scientific theory can be used to practical and effective solutions.(?)

Figure 19. Group 4--themes and benchmarks.

Back in large group discussion, was some concern about the varying levels of resolution present in the lists from the different groups. Niepold assured everyone that this was a good starting point, and the refining work will take care of any unevenness that may exist at present. He also mentioned that there are a lot of existing lessons and tools available for climate change; connections to quality resources will need to be a part of this effort. NSTA's SciGuides and Mark McCaffrey's Climate Change Collection (with his review protocol) were both discussed.

Willard then reviewed two essential criteria to consider when developing assessments:

- **Necessity:** Consider how necessary the learning goal is to performing the task or answering the question. (e.g., Is all the students need to do is to be able to read a table/graph or do they need to understand the concepts?)
- **Sufficiency** is the other key consideration; they may not know enough peripheral information to make sense. (e.g., testing *"do cheetahs eat antelopes?"* If they don't know what a cheetah is, they aren't being tested on the predator/prey concept.)

A discussion of next steps followed. Sixteen participants were still present. The first step is to take all of this and whittle it down to key concepts. A dozen or so participants volunteered to continue working on the project. There seemed to be general agreement to work towards completion of this step over the summer, with a second workshop to follow in the fall (possibly in Boulder). Possible topics at this meeting will be implementation, dissemination, scaling, and feedback loops. McCaffrey suggested a working name for the group to be Climate Literacy for Understanding the Earth System (CLUES). Plans were made to begin working via email and discussion groups towards the ongoing goals.

Final Survey

The final survey (see Appendix I) was completed by 15 attendees. Another four were planning to submit it by mail but were not received in time for inclusion of this report. A participation rate of about 80% for this survey is reflected in these results. Although the questionnaires were anonymous, based on the professional role reported by respondents it appears that six respondents (including the abovementioned four) to the registration survey did not reply to the final survey and one respondent to the final survey did not return a registration survey. Since some participants were only able to attend one or two days of the workshop, these uneven return results are to be expected. It is also possible that people reported a slightly different professional role on Friday than they did on Wednesday making tracking difficult.

The count of organizations represented on the final survey (Table 6) were similar to those listed on the registration survey.

Table 6. Attendee organizations reported on the final survey.

Agency	Count
NOAA	8
NASA	1
Others	6

Networking, group, and breakout sessions were all effective. Homework tasks were not.

The final survey asked which aspects of the workshop were most effective. Most highly rated was networking with other attendees; both the breakout sessions and large group sessions were listed often as well. The category "overall productivity towards the goals" was selected by six respondents. Homework tasks received no selections at all.

Table 7. Most effective aspects of the workshop.

What aspects of the workshop were the most effective?					
Response	Large group sessions	Breakout sessions	Networking with other attendees	Overall productivity towards the goals	Homework tasks

Count	11	10	14	6	0

The Atlases were valuable resources.

When asked if the workshop changed their understanding of Project 2061, 15 replied. Three said their understanding had not changed. Three said they now better understood the process by which the benchmarks were developed. Four said their understanding of Project 2061 was generally enhanced. Two mentioned they understood the real-world applications of benchmarks better than they had before. One participant's understanding was enhanced by finding the benchmarks that apply to climate and weather, while another appreciated the time to work with the new Atlas during the workshop to become familiar with it.

Attendees were asked about the usefulness of the curriculum development resources presented during the workshop. Those cited as being the most useful were the Atlases (10 selections), the Ocean Literacy products (three selections), and the benchmark document (three selections). The "least useful" resources quesstion didn't have as many responses (only six replied), but included two votes for Science for All Americans, two votes for the benchmarks book, and one for the Atlas.

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Group work was productive for developing learning goals.

In response to a question asking for the most productive techniques for developing learning goals during the workshop, 12 of the 13 respondents described the group work, both in breakouts and in the large group setting. One respondent specifically noted the value of "constantly changing composition of small group work, so everyone essentially worked with everyone." Two people mentioned the benchmark work as being productive. One attendee replied that once the agenda was changed to focus on concepts and principles, the work became productive.

The question about attendees' impressions of using the Project 2061 Curriculum Analysis Procedure did not result in many responses (eight tried to answer). Since the only session where this was emphasized was on the first day, it may not have stood out in participants' minds as an event they could comment on. Several people commented that this question was not relevant to the workshop or that the procedure didn't work well for this setting. One respondent commented they were already familiar with the procedure but didn't relate it to the workshop setting. Several people made more general comments in response to this question, such as:

- **Comments on what worked well about the Curriculum Analysis Procedure:**

- *Most was useful.*
- *Having an excellent resource to work from*
- *Discussion among group.*
- *Definition of Usages*
- *The jigsaw style activity*
- *Strategic thinking, focused group discussions*

- **Comments on what didn't work well about the Curriculum Analysis Procedure:**
  - *Large discussion sometimes went off-tangent*
  - *Lots of info--hope things were not left out--more time would help make sure this did not happen*
  - *Lecture by folks in charge.*
  - *Verbose references afterwards--to back up prior work.*
  - *We had to free the bonds from Project 2061 benchmarks to more freely conceptualize.*

The next question on the final survey was made almost entirely inappropriate by the modification of the workshop agenda. It asked for impressions of using the Project 2061 Assessment Analysis Procedure during the workshop. Although it was briefly described, the activities using this were not included. Most responses confirmed that they knew this was not actually a significant part of the final agenda.

Participants were then asked what techniques used at the workshop worked the best for removing sections of a curriculum that do not contribute to science literacy. Out of five responses, three said that brainstorming and group discussion were the best techniques used at the workshop for this purpose. One person specifically mentioned that comparing the group's climate themes with the existing 2061 Benchmarks was useful.

When asked about the process of identifying benchmarks for the fundamental concepts in weather and climate literacy, 12 of 14 respondents cited the large and small group discussions as the aspects of the workshop that worked well. One person specifically cited the workshop itself as being an effective framework for approaching the topic.

Conversely, aspects of the workshop that did not work well to facilitate this covered a wide variety of areas, as the following quotes illustrate:

- *A little too much plenary "word smithing."*
- *Not sure we had 100% agreement on everything.*
- *Lecturing by project leaders.*
- *What we needed wasn't all there*
- *Lack of familiarity w/ all benchmarks across spectrum hampered process slightly*
- *"Glitch" was small but important not telling people how to properly cite Atlas I benchmarks--the final doc was missing many which had been identified.*

- *Sometimes large group sessions*

Thus, getting bogged down in the large groups may have been an occasional problem, and there might have been a little too much lecture format, but none of the complaints are reinforced by significant repetition.

Finally, participants were asked to provide any additional comments on the workshop. Twelve replied; several were largely appreciative; others offered some specific suggestions for improvements on future events.

Suggestions for improvements:

- *Wireless internet access would have been nice. An electronic collaborative forum for collecting and sharing information would have helped.*
- *Let's have more people with expertise in climatology. Better organization needed.*
- *Scope & sequence needed to be better defined at beginning.*
- *No [PowerPoint presentations] at the end of the workshop; [you] lose people too easily.*
- *AAAS should consult a communications specialist to help get past some of the communication problems that can alienate some of your key audiences*
- *I was not clear about the workshop goals but am glad I was able to participate. I wonder if people from other agencies misunderstood the intent (Benchmarks 101) and did not come?*
- *Felt that the goals of the workshop (creating a set of essential principles and concepts based upon the benchmarks) were not clearly stated at the beginning of the workshop and should have been. Felt that this took time from the first day which could otherwise have been very productively spent as on days 2 & 3.*

Appreciative comments:

- *Good energy and commitment to continue the process.*
- *Thank you for launching this crucial initiative!*
- *Great, productive, valuable working group.*
- *This was good work. Now we need to move on to the next step, the sooner the better.*
- *Very excited about what will come out of this workshop.*

Workshop Logistics

The facilities for the workshop were generally regarded as good by attendees (see Table 8), as seen in the final survey. The main meeting room had one limitation, which was that they large windows could not be covered. Because of this, it was impossible to darken the room to a significant degree. This was not too much of a factor in the workshop experience since most projections were easily readable with the ambient light in the room. The thermostat in the secondary room was problematic. The controls did not seem to operate properly. One survey respondent commented on being cold and another requested drinking water be provided.

Table 8. Meeting facilities quality the workshop.

How would you rate the meeting facilities?				
Response	**Poor**	**Average**	**Good**	**No Opinion**
Count	0	1	14	0

Workshop Goals and Objectives

The overall goals of the workshop were achieved fairly well. Specific objectives were modified as the agenda of the workshop was changed to complement the group dynamics. In order to allow more time for working on the outcomes, the activities exploring the details of the Assessment Analysis Procedure were curtailed. This section reviews each goal and objective in the light of how well they were met.

Goal 1

Participants will understand how to use the Project 2061 Goals Documents (Science for All Americans, Benchmarks for Science Literacy, and Atlas of Science Literacy) in their educational work as it relates to weather and climate literacy.

Specific Objectives	Notes
An overview of Project 2061 will be presented, followed by an open discussion.	**Fully met the morning of the first day, with discussion continuing throughout workshop.**
Participants will write learning goals for several grade ranges, consider the nature and usefulness of learning goals, and question how they develop in sophistication through the grades.	**Fully met the morning of the first day.**
Participants will review a set of curriculum development resources targeting a particular benchmark.	**Met. Various curriculum development resources were reviewed and discussed for various benchmarks throughout workshop.**

Goal 2

Participants will understand the Project 2061 Curriculum Analysis Procedure to increase their ability to select or develop curriculum materials that promote student learning as it relates to weather and climate literacy.

Specific Objectives	Notes
Participants will review particular criteria in Project 2061's Curriculum Analysis Procedure	**Fully met the afternoon of the first day.**

Goal 3

Participants will understand the Project 2061 Assessment Analysis Procedure to increase their ability to select or develop assessment tasks that actually probe for student understanding as it relates to weather and climate literacy.

Specific Objectives	Notes
Participants will examine two assessment	**The Assessment Analysis Procedure was**

tasks using the Project 2061 process for analyzing an assessment.	**discussed briefly on the third day; time was limited due to modification of the agenda to extend the work on outcomes.**

Goal 4

Participants will understand techniques for unburdening the curriculum to provide more time to focus on the most essential knowledge and skills in weather and climate science literacy.

Specific Objectives	Notes
Participants will review a procedure for removing parts of the curriculum that do not contribute to science literacy.	**In the modified agenda, this topic was discussed and used at several points in the development of essential principles.**

Goal 5

Participants will establish a framework of how educational programs and developers can create climate and weather lessons using the AAAS Project 2061 research and products as it relates to weather and climate literacy.

Specific Objectives	Notes
Participants will identify benchmarks across multiple Atlas maps that are likely candidates for inclusion in the Weather and Climate Literacy fundamental concepts and essential principles document.	**This objective was met in full during the second and third days.**
Participants will select from all the selected benchmarks the top ten and the 6-8 categories for fundamental concepts and essential principles document.	**This objective was met on the third day, with continuing and expanded discussion to continue after the workshop ends.**

Appendix I—Survey Instruments

Registration Survey

Framework for Climate & Weather Education Workshop: Using The Atlas Of Science Literacy To Develop Weather And Climate Literacy (AAAS—Project 2061)

Registration Questionnaire

Please answer the following questions to enhance the evaluation of this workshop. Any identifying information will be kept confidential. Thank you for your assistance.

1. What is your professional position? _____

2. Where do you work?

Organization:
___NOAA
___NASA
___NSF
___Other; please describe _____

City, State: _____

3. How familiar are you with the AAAS Project 2061? (Check one.)

Not at all familiar	Have heard it mentioned	Somewhat familiar	Very familiar

4. How much have you worked with science literacy goals and benchmarks? (Check all that apply.)

___I use literacy goals and benchmarks in my outreach work
___I have worked on literacy goal and benchmark development
___I work with educators using literacy goals and benchmarks
___I use literacy goals and benchmarks in my communications projects
___I have not used literacy goals or benchmarks in my work.
___Other; please describe_____

5. What are your main reasons for attending this workshop?

_____

_____

For further information about the workshop evaluation, contact susan.lynds@colorado.edu.

Final Survey

Framework for Climate & Weather Education Workshop: Using The Atlas Of Science Literacy To Develop Weather And Climate Literacy (AAAS—Project 2061)

Final Day Questionnaire

Please answer the following questions to enhance the evaluation of this workshop. Any identifying information will be kept confidential. Thank you for your assistance.

1. What is your professional position? _____

2. Where do you work?

Organization:

___NOAA
___NASA
___NSF
___Other; please describe
_____

City, State:

_____

3. What aspects of the workshop were the most effective? (Check all that apply.)

___Large group sessions
___Breakout sessions
___Networking with other attendees
___Overall productivity towards the goals
___Homework tasks
___Other; please describe _____

4. How, if at all, has this workshop changed your understanding of Project 2061?

_____

_____

5. How, if at all, has this workshop changed your understanding of climate and weather literacy benchmarks?

_____

_____

6. Please discuss the usefulness of the curriculum development resources presented during the workshop:

What resources were the most useful? _____

What resources were the least useful? _____

7. What techniques for developing learning goals during the workshop were the most productive?

_____

_____

8. Please discuss your impressions of using Project 2061's Curriculum Analysis Procedure during this workshop:

What worked well?

_____

What didn't work well?

_____

9. Please discuss your impressions of using the Project 2061 Assessment Analysis Procedure during this workshop:

What worked well?

_____

What didn't work well?

_____

10. What technique(s) used at this workshop worked the best for removing sections of a curriculum that do not contribute to science literacy?

_____

_____

11. Please discuss how well the workshop facilitated identifying benchmarks for the fundamental concepts in weather and climate literacy:

What worked well?

_____

What didn't work well?

_____

12. How would you rate the meeting facilities (e.g., meeting rooms, equipment)? (Please check the appropriate box.)

Poor	Average	Good	No Opinion

13. Please include below any additional comments you would like to make on the workshop:

_____

_____

For further information about the workshop evaluation, contact susan.lynds@colorado.edu.

Appendix II—Workshop Agenda

Day One

8:30 – 8:45 Getting Started—Full Session
Participants and presenters introduce themselves. Procedural and technical details of the workshop are discussed, including a description of the evaluation that will be done for the workshop and its importance.

8:45 – 9:15 The Need for Change—Full Session
Participants explore the current state of students' understanding of important ideas in science, mathematics, and technology and discuss the need for reform efforts. A particular focus will be placed on weather and climate science within the framework of NOAA's environmental literacy priority.

9:15 – 10:00 Overview of Project 2061 & This Workshop—Full Session
A brief history of Project 2061 and the "tools" for reform developed at Project 2061. The discussion will include the major principles that influence the Project's continued efforts at reform. The discussion will begin to address a key objective of what does scientific literacy mean for students and citizens, while incorporating the AAAS Project 2061 research and findings to inform and guide the discussion.

10:00 – 10:15 BREAK

10:15 – 12:00 Writing a Learning Goal (Water Cycle)—Breakout Groups
Participants will study an adult science literacy goal on the topic of the water cycle. They will then consider the appropriate steps along the way to literacy for students at different grade levels. Participants will be asked to write learning goals for several grade ranges, consider the nature and usefulness of learning goals, and question how they develop in sophistication through the grades.

12:00 – 1:00 LUNCH

1:00 – 3:00 Curriculum Components—Breakout Groups
Participants will review a set of curriculum development resources targeting a particular benchmark. The resources will include a clarification of the benchmark, ideas students might have about that topic, phenomena that might make the learning goal believable to students, and representations that might be useful in explaining the learning goal to students. Additionally, the subjects of student misconception research, unburdening of the curriculum and the constraints of time will be explored.

3:00 – 3:30 Assignments and Reflections—Full Session
Participants will review learning goals and curriculum components that have been developed for weather and climate curricula. Homework assignment to review one benchmark for the next day is discussed.

3:30 – 4:30 Independent/Group Work—Breakout Groups

Day Two

8:30 – 8:45 Reflections & Issues—Full Session
Group will briefly discuss their reflections from the previous day and share and comments or questions they have.

8:45 – 9:30 Benchmark Study Discussion—Full Session
Participants will discuss the benchmark they studied for homework and reflect on the process they used to examine it.

9:30 – 10:15 Evaluating Instruction—Breakout Groups
Participants will break into groups and review particular criteria in Project 2061's Curriculum Analysis Procedure that can be used to evaluate how well learning experiences can help students achieve an understanding of specific learning goals.

10:15 – 10:30 BREAK

10:30 – 11:00 Evaluating Instruction (continued)—Full Session
Participants will share with the overall group their understanding of criteria in Project 2061's Curriculum Analysis Procedure.

11:00 – 12:00 Unburdening the Curriculum—Full Session
Participants will review a procedure for removing parts of the curriculum that do not contribute to science literacy.

12:00 – 1:00 LUNCH

1:00 – 2:00 Analyzing Assessment Tasks—Breakout Groups
Participants will examine two assessment tasks using the Project 2061 process for analyzing an assessment.

2:00 – 3:00 Selection of Learning Goals to Study—Breakout Groups
Participants will identify benchmarks across multiple Atlas maps that are likely candidates for inclusion in the Weather and Climate Literacy fundamental concepts and essential principles document and select goals to study as part of their homework that night.

3:00 – 3:30 Assignments and Reflections—Full Session
Participants will review their insights into the Curriculum Analysis Procedure, unburdening the curriculum, and assessment task work from today.

3:30 – 4:30 Independent/Group Work—Breakout Groups
Participants will select from all the selected benchmarks the top ten and the 6-8 categories for fundamental concepts and essential principles document.

Day Three

8:30 – 8:45 Reflections & Issues—Full Session
Participants will briefly discuss their reflections from the previous day and share and comments or questions they have.

8:45 – 10:15 Discussion of Learning Goals—Full Session
Participants will discuss the learning goals they studied for homework the previous night. Using a "consens-a-gram" rank the top ten selected benchmarks.

10:15 – 10:30 BREAK

10:30 – 12:00 Develop the Essential Principles—Breakout Groups
Participants will discuss in small groups the "consens-a-gram" rankings and the top ten selected benchmarks and begin to refine the 6-8 categories for fundamental concepts and essential principles document.

12:00 – 1:00 LUNCH

1:00 – 2:00 Develop the Fundamental Concepts—Breakout Groups
Participants in small groups will select from all the selected benchmarks the fundamental concepts benchmarks and order them into the essential principles.

2:00 – 3:00 Fundamental Concepts Discussion—Full Session
Participants, as a large group, will select fundamental concepts benchmarks and order them into the essential principles.

3:00 – 3:30 Framework Discussion—Full Session
Participants and presenters will discuss where the draft fundamental concepts and essential principles of weather and climate document next steps. Additionally, we will discuss how we can develop curricular materials using the AAAS Project 2061 research and benchmarks learning objectives to create a weather and climate literate public. Final evaluation survey is passed out in general session and collected before the workshop is adjourned.

3:30 – 4:30 Post Workshop Tea and Coffee Social