

Exploring Life Implementation Year 1, Report 2

Exploring Life NSF Evaluation

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Dr. Alec M. Bodzin, Primary Investigator
Lehigh University

EXECUTIVE SUMMARY

Teacher Profiles

- The teachers who applied to become pilot testers report a strong self-efficacy regarding the integration of the Internet and computers into instructional contexts.
- Teachers believe they are provided with adequate administrative support to implement Exploring Life in their school. Most teachers believe they have a sufficient number of computers in their school to use a Web-based curriculum.
- Schools are establishing and implementing new instructional technology plans to advance the skill levels of classroom teachers to the "next tier" of computer and Internet tool use in the classroom - integrating computers/Internet into the curriculum.
- Many participants did not have their students use the computer on a regular basis. This is significant finding since the Exploring Life materials are designed to have students interact with the computers almost daily.
- Teachers predominantly use the Exploring Life computer materials for data collection and content knowledge acquisition through use of the interactive concepts (tutorials). Most teachers (71%) do not have students use their computers to produce artifacts during the pilot testing of the materials.
- It remains unclear why a few participants did not implement the prototype materials this school year. We hypothesize that their lack of participation is due to discomfort with the initial prototype materials or their perceived inability to use a Web-based curriculum in their biology classroom. We will be monitoring these participants closely during the next school year.

Student Learning

- The scores of the pretests and posttests for all chapters show that students' content knowledge increased significantly. We cannot say how the scores compare to students who are not using the Exploring Life materials and use a textbook-centered curriculum. We will be looking at this during Year 2 of the study.
- Two learning disabled students did exceptionally well with the program. Their teacher reported that their assessment marks increased by two grades (from Ds to Bs) with the use of Exploring Life. Their grades returned to a D average when they went back to using the regular textbook curriculum. We will be investigating this finding on a much larger scale during Year 2 of our evaluation study.

- English as a second language (ESL) students do very well with the Exploring Life materials.
- Lower proficiency readers are doing very well with the visuals and the online concepts. However, they have difficulty using the materials when they are confronted with a combination of too much text and too many browser windows open on their computer screen (for example, the Chapter 36 WebQuest).
- It appears that students are having difficulty applying the concept of a calorie to an everyday situation. It is recommended that the developers provide additional examples, perhaps through Web-based interactivities, that will assist learners in understanding the application of how the energy of a calorie is used by an individual.
- It appears that students are not understanding the process of global air circulation. This topic is presented in Concept 36.2 on the Website. Field observations note that students have difficulty understanding the animations in this concept. It is recommended that the developers modify the content in this section.

Student use of Web-based materials

- Students have a tendency to skim through materials on the computer and many do not read the text carefully. Students tend to resist reading the material on the Web.

Lower level students will have problems with Webquests or other activities that require multi-tasking. This has been noted in students' reports on the using the Webquests. They report that multiple browser windows on their screen confuse them.

Misconceptions

- Chapters 7 and 8 did well to address the misconceptions that plants do not need oxygen.
- It is recommended that better teaching support materials be included to present strategies for teaching conceptual change for understanding processes that occur during both photosynthesis and cellular respiration.
- Chapter 36 may be increasing student misconceptions. In Concept 36.2, ecosystems do not change as drastically as indicated after one year of draught or rain. Furthermore, students are left with the impression that circulation cells create climate. In conjunction with the presentation of the text materials, learners are unable to reason how climate warming can occur.

Student Attitude

- Some students access the Website materials at home and after class.

- Student journals indicate that students are overall happy with the program.
- Some students commented that they prefer using the computers better than what the teacher normally does to deliver instruction.

Web-based Activities

- Some of the individual activities are too long or complex. Webquests take students an entire class period to complete, not 15 -20 minutes. Many Chapter 36 concepts are also too long.

Teacher Use of Materials

- There was a large variance to the amount of time chapter materials were used among the participants. They used the materials in their regular level biology classes for as little as three 50-minute class periods to as much as twenty-seven 42-minute periods.
- Some teachers abandon the EL program when the students review for high stakes state assessments.

Computer Use

- Teachers have difficulty structuring student use of computers. We are observing that there is a lack of pedagogical knowledge pertaining to incorporating technology into instructional contexts.
- Our data reveal that teachers, despite their years of experience, are not accustomed to using computers with the students. Teachers will require time to adjust their pedagogical styles to teaching with learner-centered computer materials. The program should include a teacher section on computer hints and suggestions of how to use computers.
- There appears to be a need to provide biology teachers with training on how to incorporate the Web in their classroom.
- In general, most participants used the computers for over 50% of their class time. Most teachers had their students use the Exploring Life materials with one student per computer. Group work was the second most common way students worked with computers.
- It appears that teachers will always have technology issues when they use the Exploring Life materials. Participants experienced a variety of problems. These problems included crashing computers, slow network connections, using the wrong

Web browser, and the inability to load helper applications and plug-ins on computers.

- Teachers have difficulty scheduling tightly reserved computer labs.
- Teachers are not adapting the program to a one computer classroom. Participants require instruction on how to use computers as learning stations.

Implementation Surveys and Journal Findings

- The results indicate that the teachers believe that the Exploring Life Cellular Respiration materials engage students actively in learning biology.
- The laboratories and many of the interactivities in the Exploring Life chapters encourage active learning of biology.
- The Exploring Life chapters present materials with which learners are familiar.
- Key aspects that helped improve students' understanding of fundamental biology concepts include students being able to work through materials at their own pace and providing visual imagery of complex biological processes.
- The interactivities and visuals helped increase the learners' understanding of the content.
- The WebQuests, Greenhouse Effects concepts, and the Explore! activities appeared to enhance students' ability to apply biological knowledge and the methods of science to important social issues.
- The Fastplants lab is an inquiry-based laboratory. Students are guided through an investigation. Many interactivities contain features of inquiry.
- Participants noted that the topics of the Exploring Life chapters are appropriate for their 9th and 10th grade biology curricula. Some teachers claim that the program is only for advanced students while other teachers report that lower level students do well.
- The Web-based interactivities helped learners to understand the concepts. The success of the program may be that it is adaptable to diverse learners. Some teachers stated that lower to average students were responding well to the materials.

Teacher Resources

1. Teacher Resources need to be organized in a practical, easy-to-use fashion for them to find what they want, when they want it.

New Interface Design

1. The new interface design appears to work well. Teachers and students are not having difficulty navigating within the Website.

Homework

- Teachers are reluctant to ask the students to use the Website as a homework assignment. They cannot assign something that everyone would not have an equal chance to complete. They are worried about the students who do not have the Web at home.

Methodology

After implementing *The Working Cell: Energy from Food*, *The Working Cell: Energy from Sunlight*, and *The Biosphere* chapters in their classrooms, participants completed a post implementation survey (Appendix A) and submitted a Web-based journal (Appendix B). These instruments were designed to address the main formative evaluation questions stated in the NSF grant proposal:

- Do the materials address the important goals of biological science teaching and learning?
- Are inquiry and activity the basis of the learning experiences?
- Are the topics of the unit and the modes of instruction developmentally appropriate?

Additional data was gathered from teacher interviews during field observations and follow-up phone interviews with each participant.

Student journals from two participants and student reaction papers from three participants were submitted.

Teacher Profiles

Eighteen participants (including one student teacher) attended the Lehigh 2000 workshop in August 2000. Eleven participants attended the NABT 2000 workshop in late October 2000. Fifteen participants attended the NSTA 2001 workshop in late March 2001. About half of the teachers who were trained to use the *Exploring Life* materials used them. It was expected that many of the NABT and NSTA workshop participants would not implement the pilot materials in the 2000-01 school year because they may have already covered the content prior to attending the workshop.

Appendix C lists the demographic characteristics of all Year 1 participants listed by item number from the Call for Participation survey.

The teachers who applied to become pilot testers reported a strong self-efficacy regarding integrating the Internet and computers into instructional contexts. They reported that they were ready to use computers for their own professional use, as well as with their students. Most teachers are early adopters (88.1%), members of a social system of biology teachers

that have embraced the use of computers and the Internet. All teachers (100%) reported that they had assigned their students Internet research tasks. Furthermore, 92.9% reported they had assigned students data analysis and problem solving tasks that involved using computers or the Internet. On average, 88.1% the Exploring Life participants have used computers for 3 or more years for teacher planning and preparation (Figure 1) and have attended professional development experiences in the three years (Figure 2). Even with a significant amount of professional development, most teachers (97.6%) reported that most of their technology training was through their own independent learning and interactions among colleagues (83.3%). Only 35.7% reported that at least a moderate extent of their training came from college courses.

Figure 1. Years teachers have used the Internet for teacher planning and preparation.

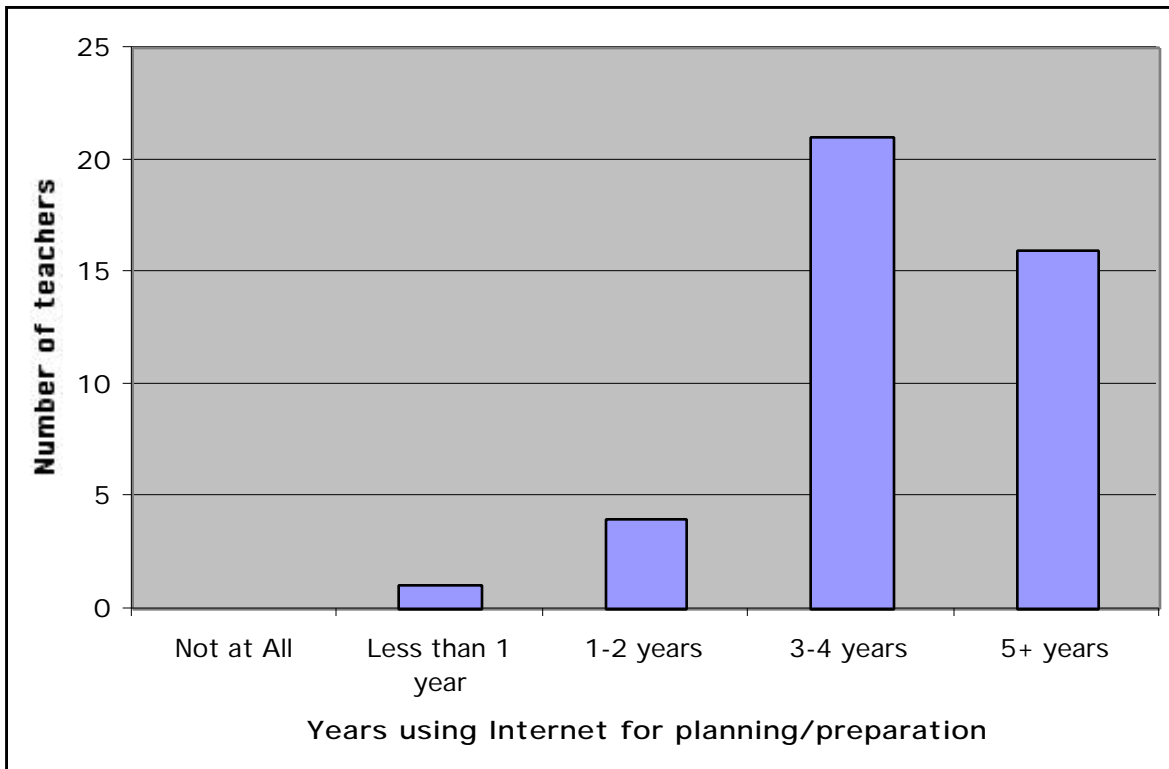
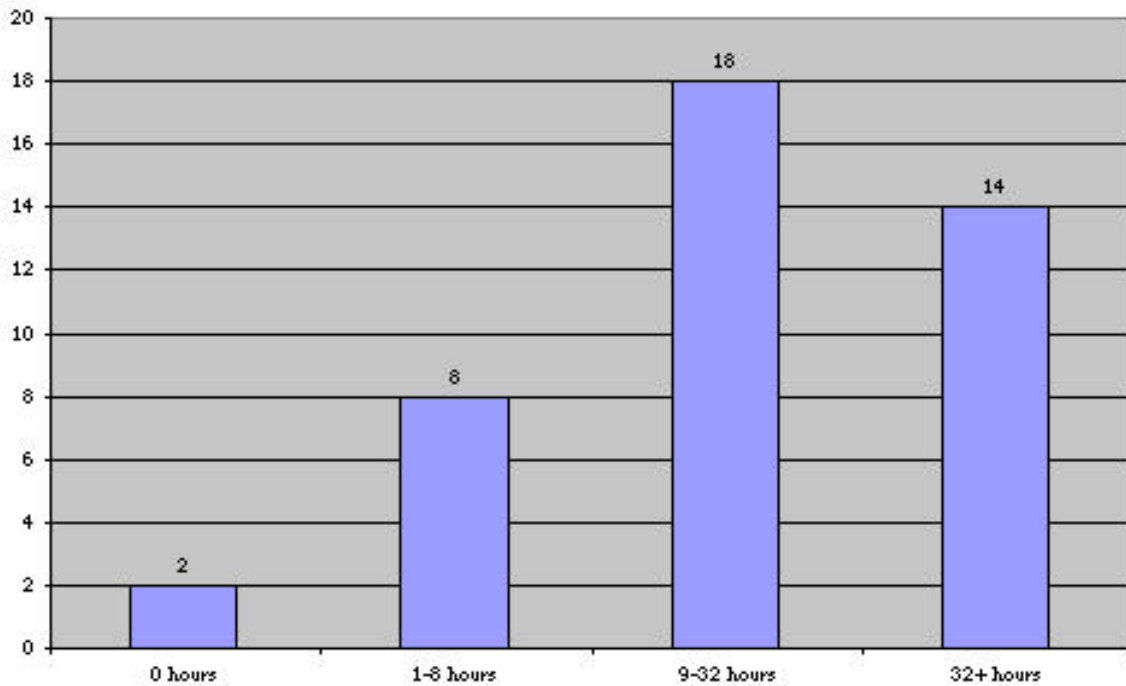


Figure 2. Formal professional development of year 1 participants using computers and the Internet during the past three years.



The data revealed that teachers were provided with adequate administrative support to implement Exploring Life in their school. Most teachers believed they had a sufficient number of computers in their school to use a Web-based curriculum. Most teachers (57.1%) reported that their school district required computer training. 33.3% percent of the participants had 10 or more computers in their classroom. 45.2% of the teachers had 2 to 9 computers in their classroom and 21.4% had only one computer in their classroom. Most teachers reported that they used a computer lab in their school.

Our data indicates that schools and teachers are establishing and implementing new school-based technology plans to advance the skill levels of classroom teachers to the "next tier" of computer and Internet tool use in the schools - integrating computers/Internet into the curriculum.

97.6% of our participants reported that they use the Internet to communicate with other colleagues. This communication network appears to be elaborate. Two-thirds of the Year 1 participants "heard" about the Exploring Life evaluation from other teachers who participate in online community science education networks. Each participant also

reported that they use the computer/Internet as a tool to create instructional materials (i.e., handouts, tests, etc.).

Based on our characteristic profile survey responses, we believed that our Year 1 participants were predominantly high-end computer users. 88.1 % of our Year 1 participants reported that they assign students to some extent class work that involves using computers or the Internet for solving problems, data analysis, word processing, spreadsheets, graphical presentation of materials, producing multimedia reports/projects, and conducting research on the Internet.

We were a bit surprised about how the teachers used the Exploring Life computer activities in their classrooms during field observations. Most Exploring Life activities were designed to be learner-centered activities and not teacher-directed activities. Many teachers did not have students use their computers to produce multimedia artifacts during the pilot testing of the materials. Teachers predominantly used the Exploring Life computer materials for data collection and content knowledge acquisition through use of the interactive concepts (tutorials). Many participants did not have their students use the computer on a regular basis. This is significant finding since the Exploring Life materials were designed to have students interact with the computers almost daily.

We experienced attrition with some participants from our first two workshops. Some attrition resulted from technical issues with using the Web-based materials in their schools. After returning to their schools from the evaluation workshop, some participants realized they did not have the minimum hardware and software system requirements on their computers to use the Exploring Life materials. To resolve this issue, a test page with a Flash animation was designed on the *Exploring Life Call for Participation* Web page. Additional participant screening was put into effect to make sure participants' school computers had all necessary system requirements to use Exploring Life. Some participants removed themselves from the study due to circumstances beyond their control, i.e. change of teaching assignment, leaving their school system, etc. Additional participants will be added to future workshops to compensate for the current attrition.

It remains unclear why a few participants did not implement the prototype materials this school year. We hypothesize that their lack of participation may be caused by discomfort with the initial prototype materials or their perceived inability to use a Web-based curriculum in their biology classroom. We will be monitoring these participants closely during the next school year.

Eighteen participants used the Exploring Life materials with their students during the 2000-2001 academic school year.

- 7 participants - successfully implemented Chapter 4 prototype
- 8 participants - successfully implemented Chapter 7 - The Working Cell: Energy from Food (includes one student teacher pair with a mentor teacher)
- 6 participants - successfully implemented Chapter 8 - The Working Cell: Energy from Sunlight
- 4 participants - successfully implemented Chapter 36 - The Biosphere

Field observations

- 1 participant - Chapter 4 prototype
- 2 participants - Chapter 7 - The Working Cell: Energy from Food
- 2 participants - Chapter 8 - The Working Cell: Energy from Sunlight
- 1 participant - Chapter 36 - The Biosphere

Detailed field observation reports are available online at:

<http://www.lehigh.edu/~inexlife/evaluation>

Teacher Use of Materials

Number of days teachers used materials

The number of classroom days the participants used the Exploring Life chapters varied greatly. Participants used the materials in their regular level biology classes for as little as three 50-minute class periods to as much as twenty-seven 42-minute periods. Tables 1-4 shows the amount of days and total minutes each pilot chapter was used in the participants' classrooms. There was a large variance to the amount of time chapter materials were used among the participants.

Table 1. *The Working Cell: Energy from Food prototype classroom use.*

	# Classroom Days	Period Length in Minutes	Total Minutes
	2	90	180
	20	52	1040
	7	42	294
	15	50	750
	5	105	525
	12	80	960
	7	83	581
	14	44	616
Average	10.25	68.25	618.25

Table 2. *Ch. 7 -The Working Cell: Energy from Food classroom use.*

	# Classroom Days	Period Length in Minutes	Total Minutes
	2	80	160
	2	90	180
	3	90	270
	10	60	600
Average	4.25	80	302.5

Table 3. *Ch. 8 - The Working Cell: Energy from Sunlight classroom use.*

	# Classroom Days	Period Length in Minutes	Total Minutes
	27	42	1134
	3	90	270
	14	52	728
	5	75	375
Average	24.5	64.75	626.75

Table 4. *Ch.36 - The Biosphere classroom use.*

	# Classroom Days	Period Length in Minutes	Total Minutes
	7	90	630
	7	50	350
	4	45	180
	3	50	150
Average	5.25	58.75	327.5

The data reveals that participants who used the laboratories spent more time using the materials. The honors classes typically used the materials for two days during a block schedule. It should be noted that one of these participants predominantly lectured to her students and used the Exploring Life Web-based materials as reinforcement to the lectures.

Exploring Life Activity Usage

The following lists the activity usage of the participants that was reported in journals, phone interviews, and field observations.

The Working Cell: Energy from Food chapter

Note: Data reported from submitted journal submissions.

4 participants - All activities

2 participants - All activities except Explore

2 participants - Online concepts only (includes one student teacher pair with a mentor teacher)

1 participant - All activities except labs

1 participant - All activities except Fastplants labs

1 participant - Computer activities only

1 participant - All Reading and Book questions

1 participant - CalorieQuest and sunlight powers life only

Chapter 8 - The Working Cell: Energy from Sunlight

Note: Data reported from submitted journal submissions.

1 participant - All computer animations and lab

1 participant - All activities except Closer Look

1 participant - Webquest, Explore and assessment quiz

1 participant - Entire chapter was taught via the EL Website. All sections/concepts.

Chapter 36 - The Biosphere

Note: Data reported from submitted journal submissions.

1 participant - The Webquest, the textbook, the concept questions on the Web and the quiz.

1 participant - All chapter online activities and part of the microscope lab.

1 participant - The Text for Ch. 36 and all the online activities, including the online quiz.

1 participant - Only computer activities: the ThermalVentQuest, Concepts 36.1-36.4 and the You are a Pond Organism pre-lab.

Activities Not Used By Participants

The Working Cell: Energy from Food chapter

Laboratory activities:

The laboratory activities were the most skipped activity. Four participants did not implement any laboratory activities. These participants noted that they did not have enough time to incorporate the labs into their curriculum. One of these participants noted that she did not have time to obtain the seeds and beads needed for the FastPlants laboratory. She thought they were being supplied with the kit and didn't make prior arrangements.

Other Web-based interactivities:

The Explore! and CalorieQuest were also mentioned as activities that were not implemented by the teachers. The reasons cited for not using these activities included not enough time or poor Web connections. Some offered the activity as an enrichment activity for students.

Teachers who did the least activities:

One teacher, who relied mostly on lecture for her instructional delivery, implemented none of the labs, Explore!, or Webquest activities. This classroom teacher felt the labs were at a higher level than that of her honors biology students. Similarly, the Explore and Webquest activities were believed to be too time consuming. The concepts that were explored were more easily presented through lectures.

A second teacher had to abandon implementing the materials when she realized her computers lacked the basic system requirements to handle the Website. Prior to using the materials, she consulted her school's technology systems administrator and was assured the computers were adequate.

Chapter 8 - The Working Cell: Energy from Sunlight

Note: Data reported from submitted journal submissions.

- One participant did not use the Closer Look activities. This participant commented that "there was too much detail in these for my students."
- One participant did not use the textbook because she wanted to see how her students did on the assessment test without it.
- One participant did not do the labs due to lack of materials or having time to order them.
- One participant offered the Explore! activity as extra credit to students who were moving ahead of the normal class pace.
- Chocolate Quest was not working properly due to bad links and was abandoned.

Chapter 36 - The Biosphere

Note: Data reported from submitted journal submissions.

- Two participants did not use the lab activity due to time constraints for obtaining pond culture tubes.
- Two participants did not use the Career: Meet and Ecologist activity. One participant did not think her students would be interested in the material offered at the time of the year and a second participant noted that the level of activity was written above the level of her students.
- One participant stated that she did not have her students complete the posttest "because the kids were having a lot of trouble understanding the concepts and they wore out their welcome in the computer lab after 2 days and were kicked out."

Additional Teacher Developed Materials Used

- 8 participants- study guides/worksheets
- 2 participants - chromatography hands-on laboratory
- 1 participant - hands-on activity
- 1 participant - concept map
- 1 participant - teacher created overheads
- 1 participant - research project on salmon decline
- 7 participants - none reported

Six participants that used the Exploring Life materials developed study guides. The study guides were used by the teachers as an accountability measure to ensure that students were working through the program and not just clicking through. Some teachers noted that they used these guided study sheets as a form of assessment. One participant used concept maps and another participant used ball and stick models to represent cellular processes.

Assessment

Teachers used a variety of assessment measures in addition to the pre/posttests and the end of the chapter quiz. Additional assessment measures reported by participants included:

- Teacher constructed quizzes and test (10)
- Exploring Life assessments -quiz, lab reports (5)
- Journal entry focused on the key idea of each concept (4)
- Oral questioning (3)
- Reproducing and explaining illustrations (2)
- Teacher constructed worksheets for Webquests (1)

Bumper sticker slogans (1)

Lab reports (1)

Computer Use

In general, most participants used the computers for over 50% of their class time. Tables 5-8 lists the classroom context in which teachers reported how students accessed computers. Most teachers had their students use the Exploring Life materials with one student per computer. Group work was the second most common way students worked with computers.

Table 5. *Computer use (in days) of The Working Cell: Energy from Food prototype.*

	Demonstration	One Student	Group Work	Learning Station	Other Setting	Total
	0	0	0	2	0	2
	1	10	2	7	20	40
	0	0	5	0	5	10
	3	12	1	0	0	16
	0	0.5	3.5	0	1	5
	0	0	8	0	0	8
	0	0	0	7	7	14
	0	0	5	1	0	6
Average	0.50	2.81	3.06	2.13	4.13	12.63

Table 6. *Computer use (in days) of Ch. 7 - The Working Cell: Energy from Food.*

	Demonstration	One Student	Group Work	Learning Station	Other Setting	Total
	0	0	2	0	0	2
	0	2	0	0	0	2
	0	3	0	0	0	3
	0	0	0	0	0	0
Average	0	1.25	0.5	0	0	1.75

Table 7. *Computer use (in days) of Ch. 8 - The Working Cell: Energy from Sunlight.*

	Demonstration	One Student	Group Work	Learning Station	Other Setting	Total
	0	20	0	0	0	20
	0	3	0	0	0	3
	0	0	0	0	0	0
	1	4	0	0	0	5
Average	0.25	6.75	0	0	0	7

Table 8. *Computer use (in days) of Ch. 36 - The Biosphere.*

	Demonstration	One Student	Group Work	Learning Station	Other Setting	Total
	0	3	0	0	0	3
	5	1	0	1	0	7
	1	1	5	0	0	7
	0	4	0	0	0	4
Average	1.5	2.25	1.25	0.25	0	5.25

Technology Implementation Issues

- No computers/not enough technology
- Scheduling problems
 - Can't get the time
 - Can't reschedule if they miss the time
- Networking problems with software
 - Internet Explorer , Flash, QuickTime, Real Player
- Network goes down often
- Students access improper materials

It appears that teachers will always have technology issues when they use the Exploring Life materials. Participants experienced a variety of problems. These problems included crashing computers, slow network connections, using the wrong Web browser, and the

inability to load helper applications and plug-ins on computers. Teachers should be aware that no matter how well they have planned, they will have to deal with students working in pairs due to not enough equipment or crashing computers.

The following lists technology issues reported by teachers and program evaluators:

- One participant had hardware problems and abandoned implementing the materials after two days.
- During two field observations, some of the computers unexpectedly quit. The teacher had to regroup students on the remaining available computers.
- The computers didn't have all of the plug-ins and time was taken for downloading.
- Poor web connections existed in some schools.
- One teacher commented that if she did not have the computers in her room, she would not have been able to schedule a computer lab since they were too busy.
- Not all the required helper applications and plug-ins were installed in the Web browsers on the computers.
- Students had to carry their computers until they found they were in range of one of the three wireless airport hubs that serviced the room. The airport hubs not located in this participant's classroom.
- Insufficient number of electrical outlets available. Students had to plug computers into high table lab counters. There were no high stools available for students to sit on, so the students had to push desks close to the counter or sit on the counter to use the computers. Batteries were unreliable.
- Systems administrators who were not knowledgeable about the computers' hardware and software.
- Difficulty in scheduling tightly reserved computer labs.

Findings: Content Assessments

Data interpretation

Individual questions were designed to address biological content acquisition, concept application, and naive science conceptions. Percentage scores were calculated for each individual question on the pre and post content assessment. Any percentage gain in a question with a mean in the lower third percentile ranking (0-33%) is considered good. A double-digit percentage gain (at least 10%) in a question with a mean in the middle third percentile ranking (34-66%) is considered good. Any percentage gain in a question with a mean in the upper third percentile ranking (67-99%) is considered good.

T-stat: A paired test was used to test for significant differences between the overall pre and posttest scores at an alpha level of .05. The hypothesis we tested is: There is no significant difference between the pretest and posttest mean scores. A T statistic (T-stat) with a level of significance (Sig) lower than .05 is considered a significant difference and the score means are not equal.

Results

The scores of the pretests and posttests for both interfaces of the Cellular Respiration chapters show that students' content knowledge increased significantly. (See Tables 9 and 10). Table 11 shows the percentage of each item that was answered correctly on the content assessments for the Ch.4 prototype. Table 12 shows the percentage of each item that was answered correctly on The Working Cell: Energy from Food (Ch.7) content assessments with the revised content and new interface. On the Ch.7 content assessment, the percentages of 11 of 12 items increased on the posttest. These percentage increases are considered good. The score of question 6 decreased on the posttest (decrease of 13.08%). It appears that students are having difficulty applying the concept of a calorie to an everyday situation. It is recommended that the developers provide additional examples, perhaps through Web-based interactivities, that will assist learners in understanding the application of how the energy of a calorie is used by an individual.

The scores listed in Tables 10 and 12 indicate that students are learning from the materials. We feel that the developers are on the right track.

- We cannot say how the scores compare to students who are not using the Exploring Life materials. We will be looking at this during Year 2 of the study.

- Modest percentage increases were noted for posttest questions 1, 4, 5, and 11 (See table 12). We will need to investigate further as to why we did not observe larger increases on the percentages on these posttest question items. We will be administering performance assessments to a sub-sample of learners to clarify these issues during Year 2 of the study.

Table 9. *Mean scores of The Working Cell: Energy from Food prototype content assessment .*

N=479	Ch.4 Pretest	Ch.4 Posttest	T-stat	Sig
Mean score	5.388 (44.9%)	7.441 (62.0%)	18.639	.001<

Table 10. *Mean scores of The Working Cell: Energy from Food content assessment.*

N=213	Ch.7 Pretest	Ch.7 Posttest	T-stat	Sig
Mean score	5.352 (44.9%)	7.930 (66.1)	15.110	.001<

Table 11. *The Working Cell: Energy from Food* prototype content assessment item scores.

Question number	Ch.4 Pretest % correct (n=627)	Ch.4 Posttest % correct (n=527)
1	58.85	73.43
2	38.92	71.16
3	46.25	80.08
4	52.95	63.19
5	70.18	69.64
6	71.61	68.12
7	35.09	60.72
8	31.42	49.72
9	17.86	35.86
10	25.36	46.30
11	60.45	66.03
12	35.73	60.15

Table 12. *The Working Cell: Energy from Food content assessment item scores.*

Question number	Ch.7 Pretest % correct (n=249)	Ch.7 Posttest % correct (n=242)	% change
1	61.33	73.17	+11.84%
2	35.55	78.46	+42.91%
3	32.97	85.37	+52.40%
4	56.25	67.89	+11.64%
5	65.23	73.58	+8.35%
6	68.36	55.28	- 13.08%
7	26.17	60.98	+34.81%
8	35.55	54.47	+18.92%
9	16.80	47.97	+31.17%
10	29.69	68.29	+41.60%
11	52.73	66.67	+13.94%
12	35.94	67.07	+31.13%

Students' knowledge of the Chapter 8 - The Working Cell: Energy from Sunlight content increased significantly (See Table 13). Table 14 shows the percentage of each item that was answered correctly on The Working Cell: Energy from Sunlight (Ch.8) content assessments. Percentage gains were observed on 16 of 17 assessment items.

- Only a modest posttest increase was observed for questions 10. Question 10 addresses a common misconception. It is recommended that better teaching support materials be included to present strategies for teaching conceptual change for understanding processes that occur during both photosynthesis and cellular respiration.
- Only a modest posttest increase was observed for questions 14. This activity is presented in Concept 8.3, page 3 on the Website. We cannot say how the scores compared to students who were assigned this concept and to those who were not assigned this concept. In Year 2, we will look at the distribution of this test item scores of students that were assigned this activity in their classroom and those that were not.
- Students' percentage scores decreased (8.92%) on posttest question 16. This is a difficult application of the materials presented in Concept 8.4 of the Website. We cannot say how the scores compared to students who were assigned this concept and to those who were not assigned this concept. In Year 2, we will look at the distribution of this test item scores of students that were assigned this activity in their classroom and those that were not.

Table 13. *Mean scores of Chapter 8 - The Working Cell: Energy from Sunlight content assessment.*

N=86	Ch.8 Pretest	Ch.8 Posttest	T-stat	Sig
Mean score	4.810 (28.3%)	7.826 (46.0%)	9.940	.001<

Table 14. Chapter 8 - The Working Cell: Energy from Sunlight content assessment item scores.

Question number	Pretest % correct (n=122)	Posttest % correct (n=136)	% change
1	32.79	55.88	+23.09%
2	31.97	68.38	+36.41%
3	46.72	61.03	+14.31%
4	32.79	55.15	+22.36%
5	31.15	61.03	+29.88%
6	23.77	50.00	+26.23%
7	28.69	65.44	+36.75%
8	16.39	34.56	+18.17%
9	15.57	38.24	+22.67%
10	17.21	26.47	+9.26%
11	25.41	43.38	+17.97%
12	28.69	46.32	+17.63%
13	32.79	46.32	+13.53%
14	31.15	39.71	+8.56%
15	18.03	38.97	+20.94%
16	29.51	20.59	-8.92%
17	21.31	38.97	+17.66%

The content assessment scores of the pretests and posttests of Chapter 36 - The Biosphere chapter shows that students' content knowledge increased significantly (See Table 15).

Table 16 shows the percentage of each item that was answered correctly on the content assessments. Percentage gains were observed on 13 of 15 assessment items.

- A posttest percentage decrease was observed on questions 6. It appears that students are not understanding the process of global air circulation. This topic is presented in Concept 36.2 on the Website. Field observations noted that students had difficulty understanding the animations in this concept. It is recommended that the developers modify the content in this section.
- A posttest percentage decrease was observed on question 11. It appears that students are having difficulty applying the concept of the interrelationship of biotic and abiotic

factors in an ecosystem. It is recommended that additional examples be included in the teacher support materials to assist teachers in teaching this concept.

- A very small percentage gain was observed for question 9 (1.17%). This is a low level recall question from the textbook.
- Only modest increases were observed for questions 4, 7 and 8. These are low level recall questions from the textbook.

Table 15. *Mean scores of Chapter 36- The Biosphere content assessment.*

N=89	Ch.36 Pretest	Ch.36 Posttest	T-stat	Sig
Mean score	5.770 (38.5%)	7.215 (60.1%)	4.789	.001<

Table 16. *Chapter 36- The Biosphere content assessment item scores.*

Question number	Pretest % correct (n=169)	Posttest % correct (n=91)	% change
1	70.41	85.71	+15.30%
2	59.76	74.73	+14.97%
3	49.11	67.03	+17.92%
4	47.34	56.04	+8.70%
5	33.14	61.54	+28.40%
6	13.61	12.09	-1.52%
7	10.65	17.58	+7.03%
8	70.41	78.02	+7.61%
9	26.63	27.47	+1.17%
10	19.53	43.96	+24.43%
11	37.87	26.37	-11.50%
12	20.12	39.56	+19.44%
13	34.32	47.25	+12.93%
14	21.30	41.76	+20.46%
15	23.08	51.65	+28.57%

Findings: Implementation Surveys and Journals

Implementation Survey Results

Tables 17-20 display the results of the Post Implementation surveys for the Exploring Life pilot chapters. In general, these results indicate that the teachers believe that the Exploring Life Cellular Respiration materials engage students actively in learning biology. They utilize some features of inquiry in the delivery of content. They contain unit topics and modes of instruction that are developmentally appropriate for the majority of the sampled population of students. Finally, the materials address important goals of biological science teaching and learning. Each survey item is discussed in more detail in the sections below.

The scores on the teacher materials should be taken with caution and do not represent the quality of the product. It should be noted that the Exploring Life teacher support materials were not fully developed during the implementation of these materials.

Table 17. Ch.4 Post Implementation Survey Likert item responses.

Scale: 1-Strongly disagree, 2- Somewhat disagree, 3- Neutral, 4- Somewhat agree, 5- Strongly Agree (n=7)

- The Exploring Life materials promote constructivist learning in the biology classroom.
Mean = 4.4286 St. Dev.= .5345
- The Exploring Life materials encourage active learning for all students.
Mean = 4.2857 St. Dev.= .7559
- The Exploring Life materials did not improve my students' understanding of fundamental biological concepts.
Mean = 1.8571 St. Dev.= 1.0690
- The Exploring Life materials helped to increase my students' self-confidence in and skill in scientific reasoning and inquiry.
Mean = 3.5714 St. Dev.= .7868
- The Exploring Life materials enhanced my students' ability to apply biological knowledge and the methods of science to important social issues.
Mean = 3.7143 St. Dev.= .4880
- The Exploring Life **teacher support** materials assisted me in implementing the materials in my classroom.
Mean = 3.8571 St. Dev.= .3780
- Inquiry is the basis of the learning experience with the Exploring Life materials.
Mean = 4.4286 St. Dev.= .5345
- The topics of the Exploring Life chapter and the modes of instruction are developmentally appropriate for my students.
Mean = 4.1429 St. Dev.= 1.2150

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	7	4.00	5.00	4.4286	.5345
Q2	7	3.00	5.00	4.2857	.7559
Q3	7	1.00	4.00	1.8571	1.0690
Q4	7	2.00	4.00	3.5714	.7868
Q5	7	3.00	4.00	3.7143	.4880
Q6	7	3.00	4.00	3.8571	.3780
Q7	7	4.00	5.00	4.4286	.5345
Q8	7	2.00	5.00	4.1429	1.2150

Table 18. Ch.7 Post Implementation Survey Likert item responses.

Scale: 1-Strongly disagree, 2- Somewhat disagree, 3- Neutral, 4- Somewhat agree, 5- Strongly Agree (n=7)

- The Exploring Life materials promote constructivist learning in the biology classroom.
Mean = 4.2500 St. Dev.= .4629
- The Exploring Life materials encourage active learning for all students.
Mean = 4.1250 St. Dev.= 1.1260
- The Exploring Life materials did not improve my students' understanding of fundamental biological concepts.
Mean = 2.0000 St. Dev.= .9258
- The Exploring Life materials helped to increase my students' self-confidence in and skill in scientific reasoning and inquiry.
Mean = 3.5000 St. Dev.= .7559
- The Exploring Life materials enhanced my students' ability to apply biological knowledge and the methods of science to important social issues.
Mean = 3.2500 St. Dev.= 1.3887
- The Exploring Life **teacher support** materials assisted me in implementing the materials in my classroom.
Mean = 2.8750 St. Dev.= 1.5526
- Inquiry is the basis of the learning experience with the Exploring Life materials.
Mean = 4.1250 St. Dev.= .3536
- The topics of the Exploring Life chapter and the modes of instruction are developmentally appropriate for my students.
Mean = 4.1429 St. Dev.= 1.2150

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	8	4.00	5.00	4.2500	.4629
Q2	8	2.00	5.00	4.1250	1.1260
Q3	8	1.00	4.00	2.0000	.9258
Q4	8	2.00	4.00	3.5000	.7559
Q5	8	1.00	5.00	3.2500	1.3887
Q6	8	1.00	5.00	2.8750	1.5526
Q7	8	4.00	5.00	4.1250	.3536
Q8	7	2.00	5.00	4.1429	1.2150

Table 19. Ch.8 Post Implementation Survey Likert item responses.

Scale: 1-Strongly disagree, 2- Somewhat disagree, 3- Neutral, 4- Somewhat agree, 5- Strongly Agree (n=6)

- The Exploring Life materials promote constructivist learning in the biology classroom.
Mean = 4.3333 St. Dev.= .5164
- The Exploring Life materials encourage active learning for all students.
Mean = 4.3333 St. Dev.= .5164
- The Exploring Life materials did not improve my students' understanding of fundamental biological concepts.
Mean = 2.5000 St. Dev.= .8367
- The Exploring Life materials helped to increase my students' self-confidence in and skill in scientific reasoning and inquiry.
Mean = 3.8333 St. Dev.= .7528
- The Exploring Life materials enhanced my students' ability to apply biological knowledge and the methods of science to important social issues.
Mean = 3.3333 St. Dev.= 1.0328
- The Exploring Life **teacher support** materials assisted me in implementing the materials in my classroom.
Mean = 3.1667 St. Dev.= 1.1690
- Inquiry is the basis of the learning experience with the Exploring Life materials.
Mean = 3.6667 St. Dev.= 1.0328
- The topics of the Exploring Life chapter and the modes of instruction are developmentally appropriate for my students.
Mean = 4.3333 St. Dev.= .8165

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	6	4.00	5.00	4.3333	.5164
Q2	6	4.00	5.00	4.3333	.5164
Q3	6	2.00	4.00	2.5000	.8367
Q4	6	3.00	5.00	3.8333	.7528
Q5	6	2.00	5.00	3.3333	1.0328
Q6	6	2.00	5.00	3.1667	1.1690
Q7	6	2.00	5.00	3.6667	1.0328
Q8	6	3.00	5.00	4.3333	.8165

Table 20. Ch.36 Post Implementation Survey Likert item responses. (n=7)

Scale: 1-Strongly disagree, 2- Somewhat disagree, 3- Neutral, 4- Somewhat agree, 5- Strongly Agree

- The Exploring Life materials promote constructivist learning in the biology classroom.
Mean = 4.2500 St. Dev.= .5000
- The Exploring Life materials encourage active learning for all students.
Mean = 3.7500 St. Dev.= 1.2583
- The Exploring Life materials did not improve my students' understanding of fundamental biological concepts.
Mean = 2.0000 St. Dev.= .8165
- The Exploring Life materials helped to increase my students' self-confidence in and skill in scientific reasoning and inquiry.
Mean = 3.0000 St. Dev.= 1.1547
- The Exploring Life materials enhanced my students' ability to apply biological knowledge and the methods of science to important social issues.
Mean = 3.0000 St. Dev.= 1.1547
- The Exploring Life **teacher support** materials assisted me in implementing the materials in my classroom.
Mean = 4.2500 St. Dev.= .5000
- Inquiry is the basis of the learning experience with the Exploring Life materials.
Mean = 3.5000 St. Dev.= 1.7321
- The topics of the Exploring Life chapter and the modes of instruction are developmentally appropriate for my students.
Mean = 3.3333 St. Dev.= 1.1547

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	4	4.00	5.00	4.2500	.5000
Q2	4	2.00	5.00	3.7500	1.2583
Q3	4	1.00	3.00	2.0000	.8165
Q4	4	2.00	4.00	3.0000	1.1547
Q5	4	2.00	4.00	3.0000	1.1547
Q6	4	4.00	5.00	4.2500	.5000
Q7	4	2.00	5.00	3.5000	1.7321
Q8	3	2.00	4.00	3.3333	1.1547

The following sections include selected teacher comments from the Chs. 8 and 36 Post Implementation Survey and Journal responses. Ch.7 responses were reported in the *Cellular Respiration Chapter Implementation Report Year 1*.

Active Learning of Biology

The laboratories and many of the interactivities in the Exploring Life chapters encourage active learning of biology. Learning is something that students do with the Exploring Life materials. Participants noted that students are actively engaged in learning biology with the Webquest, laboratories, Explore! and interactive animations that provide immediate feedback. Participants did note that interactivities such as watching the pinball animation did not assist learners in understanding the concepts being presented. Of the four participants using Chapter 36 with their students, two commented that they did not think this chapter promoted active learning of biology.

Selected comments:

- I also especially liked the lab simulations. It is a much more manageable means of doing labs with large groups. It shouldn't replace actual lab experiences, but it can provide experiences that could not otherwise be done in a class of 30 ninth grade students.
- The ThermalVent Quest definitely. The others were too passive. The pre-lab was fairly engaging and they were able to practice using taxonomic keys.
- The laboratory activities fall into this category as students take a hands on approach to understanding the concepts. But, also, active learning is most certainly going on as the students interact with the Website. Specifically I believe the animations promote active learning. It was the animations that I felt were the strongest component of the program, many students returned to them several times.

Constructivist learning in the classroom

The Exploring Life chapters present materials with which learners are familiar. The WebQuests introduce the main ideas of the chapter in a context that is meaningful and relevant to the learners. These ideas are developed further as learners engage in interactive simulations and hands-on laboratories.

Selected comments:

- If constructivist means being able to build on ideas, they were able to see how abiotic factors and biotic factors interact and then should have been able to explore that more thoroughly during the Pond lab.
- The topics were sequential and built upon previous assignments.
- Began with material with which students are familiar: food, the carbon cycle (relationship of plants and animals).

Improving students' understanding of fundamental biological concepts

Key aspects that helped improve students' understanding of fundamental biology concepts include students being able to work through materials at their own pace and providing visual imagery of complex biological processes.

Selected comments:

- There were still a group of students that wanted to race through the material to be able to play a game.
- It improved my students understanding of fundamental concepts by using charts and graphs, pictures and query to get them to take notice of the topic of habitats, biomes, and how they work together. The problem is that some of them don't get hooked or motivated in this manner. For some this is strictly a game machine. I had many comments that this should be supplemented with traditional methods of instruction also. Surprise surprise!
- I think they saw better relationships between structure and function in the biomes (animal/plant adaptations) as well as gained a better conceptual relationship of pond organisms and abiotic factors affecting their survival

Increasing students self-confidence and skill in scientific reasoning and inquiry

The interactivities and visuals helped increase the learners' understanding of the content. The questions provided with the interactivities enabled students to think more critically about the presented concepts. Participants noted that their students were more prepared to implement the laboratory protocols when they used the online laboratories prior to the actual implementation.

Six participants did not think that the materials helped to increase the students' self-confidence and skill in scientific reasoning and inquiry.

Selected comments:

- Cannot say that it did.
- I don't see that they did. The website does a nice job of showing stuff off with great visuals. That is very important, but they were struggling so much with vocabulary that the inquiry didn't quite happen. And the section where they were to change the temp. and the water amounts -- if that was supposed to be inquiry --did not work well. They skipped through, without understanding.
- Having only done 2 chapters of Exploring Life, I saw some improvement in my student's scientific reasoning and inquiry skills. Because it was limited to a few weeks of instruction, I didn't see a huge improvement, but I would expect that with this mode of instruction throughout the year, students would show a greater amount of improvement and they would gain more confidence.
- Did not really change due to extensive exposure previously. Our school does an extensive study on the nature and history of science. If they had not had this background I would say that the EL materials would have contributed more.
- I'm not sure that they did. What evidence would I look for?
- My students still have a difficult time reading and following directions which I am working on. My students want to be told the answer because it is easier than thinking. The labs had very good result and if used with good pre and post lab discussions are very effective. I'm not sure that the materials increased their self confidence but their skills in reasoning and inquiry were evident by the way they manipulated the materials and equipment.
- They were initially intimidated, but soon became comfortable with the format. As they began to understand the concepts they gained more confidence.

Enhancing students' ability to apply biological knowledge and the methods of science to important social issues

The WebQuests, Greenhouse Effects concepts, and the Explore! activities appeared to enhance students' ability to apply biological knowledge and the methods of science to important social issues.

Four participants noted they did not see how the materials in Chs.8 or 36 enhanced their students' ability to apply biological knowledge and the methods of science to important social issues.

Selected comments:

- I do not see how this enhanced their abilities with this particular unit on application of important social issues. This may be because I missed something? :)
- I am honestly not sure. I did not use the Web Quests, the Photosynthesis Unit or the labs.
- It did not because the program was not completely implemented. However the Chocolate activity has the potential to do so.
- We had talked about the Greenhouse Effect. The students didn't realize what it really was and how photosynthesis would have any connection whatsoever. After completing the chapter and discussing it, students were able to intelligently connect what they'd learn.
- In this chapter the concept was related to several ideas that students were already familiar with which have social impact. It was easy to find recent articles about the greenhouse effect. Ethanol as an alternate fuel was also in the news at the same time as Wisconsin gas prices went through the roof. Both of these concepts tied in well. Having students analyze data from the Hawaiian observatory helped students clarify the importance and value of long term data collection and analysis.
- With photosynthesis, we were able to touch on global warming and begin to explore the data that supports this interpretation of the last 50 years. I think this was the first time my students had seen an actual application of something so scientific and abstract to "real life" This was essentially an introduction for them. Their ability to apply their knowledge would come with time and experience, as they see more "real world" applications of what they are learning.
- With photosynthesis, we were able to touch on global warming and begin to explore the data that supports this interpretation of the last 50 years. I think this was the first time my students had seen an actual application of something so scientific.
- I think that the kids were dazzled by the colorful moving objects -- too dazzled to think about those deep social issues.

Teacher Support Materials

It should be noted that the Exploring Life teacher support materials were still in the conceptual development stages during the first year pilot testing. Additional teacher resources appeared in the new interface. This section is still under development and is not yet complete.

Selected comments:

- The teacher material did not assist in the implementation of Exploring life. I would have like to have been given more implementation strategies. In other words, ways in which you could successfully implement the activities and or sequence of events.
- I was part of the crew when things were switching. At times that was kind of difficult. The biggest stumbling block was lab instructions. They need to start at 0 for people who have no experience or information. For example, I know how to make KOH, but the teacher materials need to be specific and explain that. Also, for the Sodium Bicarbonate, the directions said to get a beaker and sprinkle Sodium Bicarbonate on bottom. I teach the students to measure everything when they are doing labs. I have also expressed a need for other handouts that can be printed from the Web site.
- We did the test piloting materials cleanly in 5 days w/ only the use of the materials. Implies goals and procedures were clear.
- The teacher support materials have great ideas about in what order to do things (text vs. online); the reminders about students answering questions and suggestions of having a personal journal were very useful; the tip about the pinball game was RIGHT ON!!

Use of inquiry

The Fastplants lab is an inquiry-based laboratory. Students are guided through an investigation. Next, they are prompted to formulate their own driving question, conduct a second investigation where they gather and analyze data, and formulate a conclusion.

Many interactivities contain features of inquiry. Each Exploring Life laboratory, Webquest and Explore! Activity in the pilot chapter will be analyzed using the Web-Based Inquiry for Learning Science (WBI) instrument during the Lehigh 2001 workshops.

Selected comments:

- Students are often asked to hypothesize what will happen before testing out the manipulation of certain variables in the online activities. For instance, in online activity 36.1, students are asked to hypothesize what will happen if the amount of sunlight changes or the amount of water changes. After they hypothesize, they can test it out and see if their hypothesis was correct. Another example is in Concept 36.4 where students are asked to predict which ocean environment certain marine organisms could live in based on their characteristics or adaptations. Students can see if they are right when they try to drag and drop the organisms into the different

environments. In one sense, this is inquiry. In the strictest definition of "inquiry," there wasn't much in Ch. 36 that allows students to formulate a question, research it and develop a testable hypothesis and then a procedure, collect and present data, analyze data and draw conclusions. There was one suggested activity in the Ch. review activities in the text that fits.

- I don't think inquiry is there. I suppose it could be with the pond lab, but they are supposed to get materials and think up their own projects -- and that is not what I see in the chapter.
- In ways the introductory webquest provides some food for inquiry, but my thoughts are that inquiry based learning is more hands on. Perhaps if I had started with some cocoa leaves and then sent them on the webquest the learning would of felt more inquiry-based.
- There are many open-ended questions. Too often my students seem to want to be told what is going to happen or have been insecure with being wrong. The material often leaves several answers or modes of interpretation. The lab on photosynthesis using different kinds of leaves and opening the way for changing variables leads to inquiry.

Developmentally appropriate modes of instruction

Participants noted that the topics of the Exploring Life chapters are appropriate for their 9th and 10th grade biology curricula. Most participants stated that the modes of instruction are developmentally appropriate for their regular level and honors biology students. The concepts are presented in an appropriate sequence. The Web-based interactivities helped learners to understand the concepts. An interesting phenomenon appearing here is that some teachers claim that the program is only for advanced students while other teachers report that lower level students do well. The success of the program may be that it is adaptable to diverse learners. It also may be a result of using content materials that are often not covered thoroughly in regular and lower level biology courses.

Selected comments:

- The ThermalVent Quest was wonderful for my students. The questions were tough on the other sections, but they seemed to really get into the ThermalVent Quest. They liked the page on Alvin because they have all heard of it. These students don't know a lot of science and feel uncomfortable when information is hard to get at and when there seems to be a lot at one time. I felt that the kids paged through a lot of the concepts without truly understanding what was going on because they were able to go forward without answering the questions. I think adding some type of barrier to further progress like a mini-quiz they have to pass would be useful. They'd also feel

like they are learning something. Pitsco, the software I was using last year does this and the kids really get into the quizzes and become competitive. I think that students who are comfortable on the computer will do well; also students who are moderately comfortable with science and have a good middle school science background will do well. The kids say they want more graphics, more explanations, fewer picky questions and fewer difficult words.

- They flow very well, with each section building on the concept of the previous one. It is very appropriate for tenth grade biology the way it is taught in Tennessee.
- These are difficult concepts for students to comprehend. The visual activities helped them relate to the information and to assimilate it. They are computer savvy and skilled at computer games and this took advantage of this to keep their interest
- The topics are standard fare for high school Biology, but I especially liked the mode of instruction. It is especially well adapted to the "Sesame Street" generation that we are teaching now. Our students tend to be high visual, but not very imaginative.

Teachers perceptions' of their student reactions to Exploring Life

Below are the comments from the teachers pertaining to their student reactions to the materials. Note that some of the teachers stated that lower to average students were responding well to the materials. In our teacher focus groups and in response to other survey items, some teachers perceived that the material was best suited for higher level students.

The data reveals other interesting teacher perceptions of student use of computers. Teachers noted that the computer was taking over much of the responsibility of the instructional delivery. Some of the *negative* comments from the teachers stated that the students learned better from them, not the computers. Perhaps the importance of the teacher in the "vital new role of facilitator" should be emphasized in the *Exploring Life Teacher Resource Materials*.

Selected comments:

Positive

- In general it was my impression that they liked this chapter. I still had a few that didn't take it seriously, but many of them made positive comments. Some of them wanted to know more, which I liked. They liked the videos and graphics.
- The overall reaction was quite positive. The kids enjoyed the pictures, graphics and the animations. They are quite visually-oriented. In fact, they wanted more visuals. They had a tough time flipping from one web page to the other when answering

questions and they also had some difficulty with the vocabulary level used. The favorite part was the Thermal Vent Quest. They loved looking at the smoking vent and at the animals that live nearby. They worked hard on answering the questions -- harder than for many other tasks we've done all year which to me indicates they *really* liked the lesson.

- Several of my students enjoyed this tremendously. In fact, their grades came up by a whole letter grade. A few students did not like being on their own to complete activities. They like the lecture format. Though, they adapted and their grades did not differ. On the last test I asked the students what they liked best, least, etc. They enjoyed being able to work on their own at their own pace on a concept. They could go through it as many times as needed to understand. They enjoyed the animations and the detail to some of them. For example, inside the lizard's tail there was structure not just empty space. They thought the lab investigations were difficult and they needed explanations from me on many items. They did like being able to see how a lab was supposed to work with the equipment.
- They loved being able to use the computer simulations and examining the living organisms under the microscope. They stated that they liked this better than the text we are currently using.
- The journal described above was also used for students to record their reactions to the EL materials. Here is a summary of what I read in those journals and what they told me in person as they worked.
 1. Nearly all commented that they thought the text was very reader friendly. They liked the simple organizational style and the down-to-earth language.
 2. Nearly all of them preferred doing the EL online activities to more traditional paper and pencil types of concept-building activities. I asked specifically if they thought they would get bored doing them on a regular bases (every chapter) and most thought they would not, as long as there was variety in the activities.
 3. They all liked the WebQuest activity and were enthusiastic in the discussion at the end of that day. They seemed to get a good idea of what the activity was about...biotic and abiotic conditions/interactions in a very unusual ecosystem.
 4. Concept 36.1 was thought by many to be too long for the simple concept it was attempting to teach. The others they thought were good, and some liked 36.1 just fine, but many thought that it took too much time to go through all the options/pages. They liked 36.3 and 36.4 best, I think, because they were able to create a climatogram and match animals with habitats. I think they like that dragging and dropping type of activity for some reason.

5. Several commented that the quiz at the end of the online activities and the chapter review at the end of the text were both helpful and appropriate. (I liked the variety of question types and the variety of thinking skill levels addressed.)
6. Nearly all students were on task a high degree of the time allowed for working on both the text reading and the online activities.
7. They all liked the immediate feedback available with the questions. They liked being able to type in their answers then check to see if they were correct.
8. There was some confusion in viewing the various pages within a concept. Some activities moved students automatically to the next page while others required students to use the page links in the upper right corner to go on.
9. One specific comment from a student that I thought was an excellent idea was that, in the text, when a reference is made to "see figure 36.3" or whatever, it would be helpful if that was in italics or in color, to call attention to students so that they are more likely to look at it, but also to help them find their way back easily to where they left off in the reading.
10. In general, the reactions were very positive.

Neutral

- Many of the student were easily distracted and tried to rush through the material. I thought this was mostly due to the end of the year approaching, but I have found some renewed interest with the next chapter. I have had more students rush to get something turned in so they can do something else. A few, I have guessed, have only put in letters, and not read the questions or tried to answer them reasonably. I base this on the time it took them to finish this. I don't feel very confident that the majority of my students did the best they could.
- As the newness wore off of the new program the students seemed to want more feedback as to how they were progressing.
- Like most things that are new or different they were resistant to the process at first but warmed up to it and were quite comfortable after that.
- Students in my classes tended to rush through the computer portions. Those that took their time with that portion seemed to find it of interest.
- The students thought it was "fun", but some materials were not well-utilized.

Negative

- Students frustration was high upon losing emailed quizzes to teacher because of wrong email address
- A student commented that they had difficulty
- Much of the material was at too high a level for my ninth graders - they didn't GET it without a lot of extra help from me.
- Interestingly after the completion of the activity, a student stated that they did not learn the concepts from the program but rather from the lectures.

Lower level students

- Even my curmudgeonly student was interested!
- I really felt my learning disabled population did pretty well with the format.
- My weaker students had the most difficulty with my approach of allowing them to receive the first information from the program.
- My average students asked the best questions when I reviewed the information the next day.

Participant suggestions for improving Exploring Life

- I like the idea of interactive activities with this. We have a creek here at school which flows into the Mississippi. There is a lot of potential to share data about water analysis like creek surveys, pond organism comparisons, temperature, etc.
- The teacher materials need to be improved. Details should be given in the lab set-ups for teachers, for example correct measurements. Worksheets or study guide sheets should be included. Alternate labs would also be nice.
- Despite my assurances that they weren't going to be graded on it, some of the kids got lost going from web page to web page and I had to clear out dozens of duplicate windows. They would not have a problem if they were more computer literate. I suggest that more information is given to the students while they are answering questions. For example, when asked which kingdoms they expected to see represented during the Pond pre-lab, they ought to be given the 5 kingdoms with examples. They also had a tough time with the vocabulary on the links (chemosynthesis), but that is difficult to control. A side bar with definitions would be helpful. I was disappointed that the kids didn't take to the workbook at all. They don't like to read, no matter how colorful the book. I had them use the workbook to answer some questions; the better readers did fine, but the others seemed to be scanning for answers the way they do with all of their other texts.
- I did not get the impression that students really learned much during the sections where they were increasing the temp or changing rainfall. There need to be some

simpler questions to keep them focussed. Also, the circulation cells animations were too small and I also don't think that the kids learned much that they could apply. They have no difficulty moving the cells and watching the changes on the map -- but are they applying this to anything? I didn't think so. I would take regions, show the cells, then give the kids a virtual tour through the area so they could really see the effects on the biota. It would expand the chapter nicely. I also think that a nature walk could be incorporated into the unit, especially since I see this being taught at either the beginning or the end of the year when it is nice out.

- Make the text, concepts, etc. fit on a smaller screen so you don't have to scroll left and right to read.
- None other than a means of immediate GRADED feedback from the web materials.
- When there is a response boxes in the computer portion and students are asked to check there answer- I would like it if they had to have a key word before they see the suggested answer.
- I would also like it if pages with response blocks would print with student responses intact..my students tend to be less likely to complete activities which don't have a product of some kind at the end.
- I didn't like the printed chapter review. There were too many instances where the questions required prior knowledge that I did not feel would have been introduced in the previous chapters, if we'd been using the series.
- E-mail quizzes need to be saved by server because many were misdirected due to email address mistakes. A second possible solution would be to allow teacher to input his own email address prior to student access.
- Materials were good and the colored copies are great.
- The quiz needs to be easier or in a different form. The students didn't feel it was a fair assessment. I didn't think the questions on the Explore! and Webquest could be graded easily either. I didn't have any students that got them all right (even my good kids who I know worked on it) and the majority would have had failing grades which I don't find to be my goal in presenting material.
- Have two pathways - one for honors and one for regular students. All the detail about the different reactions involved is WAY more than I expect them to learn. I concentrate on the big picture at this level.

Findings: Field Observations, Phone Interviews, and Discourse Analysis

Student use of Web-based materials

- Students have a tendency to skim through materials on the computer and many do not read the text carefully. Students tend to resist reading the material on the Web.

Web-based Activities

- **Some of the individual activities are too long or complex.** Webquests take students an entire class period to complete, not 15 -20 minutes. Many Chapter 36 concepts are also too long.
- **Pay special attention to how long activities really take for students to complete.** Can they really be done if the students have to take 10 to 15 minutes of class time to move to the computer room, settle in, and then do the activity? Classes with lower level students have high absentee rates. It is difficult to do activities that take two class periods.
- **Pay attention to the academic level of students.** Lower level students have shorter attention spans, get physically tired from reading, and become bored easily. For example, the students liked the abiotic factors activity, but it was too long to keep their attention.

Implementation Issues - Pedagogy

Teachers have difficulty structuring student use of computers. We are observing that there is a lack of pedagogical knowledge pertaining to incorporating technology into instructional contexts.

- Teachers' use of computers. One of the most effective things computers do is become teaching machines for computer assisted instruction (CAI) and tutorials. Most participants (n=37) noted in their survey responses that they assign their students this type of work either not at all or to a small extent. However, we are observing teachers in the classroom implementing Exploring Life as CAI for concept reinforcement.
- There appears to be a need to provide biology teachers with training on how to incorporate the Web in their classroom. A few participants noted they were glad they came to our workshop before using the materials in their classroom.
- Most teachers are not able to use their computers as work stations in their classrooms.

- Most teachers are not able to use the EL interactivities as demonstrations.
 - Can't hook up to television
 - No audio visual equipment
- Many teachers use the computer as a textbook (reading for content knowledge and not application).
- Some teachers abandon the EL program when the students review for high stakes state assessments.
- The teachers are going to need time to adjust their teaching. It appears one of the most significant reasons for not using computers is lack of time for them to do planning. This is important because teacher time is a large issue for everything.

Teacher Comfort Level

- Not able to rely on the Web for times of stress - concern about reliability of the network.
- Loss of control. Reliance on technology support.
- Students more comfortable with the site than the teachers
- Not used to role as a facilitator, moving from student-to-student instead of "sage on the stage."
- Spend a bit more time determining what can really be expected from teachers to do in the classroom. Teachers may be less prepared than we thought to seamlessly change their teaching habits. The Web may be more foreign than we anticipated. It appears that our participants who are "early adopters" to technology have been using the Internet for their own enrichment, getting ideas, and mostly communicating with other teachers. There are far less examples of them using it with the students. This may be one reason we are seeing some attrition; this is a more complex task than they imagined.
- The teachers are far more confident they can teach by using computers **with students** than they really are.
- Make sure teachers will feel comfortable that they can manage the students and the program.

Recommendations to address school-based technology problems

- Build a section for system managers.
- Build a teacher section on computer hints and suggestions of how to use computers.
- Make our teachers "helpers" for the teachers coming on-board.

- Go into the schools with a team of persons who evaluate the individual schools and provide teachers with an organization plan.

Teacher Resources

- Teacher participants commented that Teacher Resources should be included on the Web as well as in the book.
- Teacher participants prefer the approach the development team has taken with Chapter 8 Teacher Resources and related support documentation.
- Teacher Resources need to be organized in a practical, easy-to-use fashion for them to find what they want, when they want it.
- Teacher participants prefer to have a variety of resources to pick and choose from.
"TR can never be by definition overkilled."
"I find that there is never such a thing as overkill when it comes to having possible suggestions to improve student learning. Bring it on!"
Having a wide range of choices for classroom activities, homework assignments, and assessment materials will save teachers time since it means that individual teachers don't have to create the materials.

New Interface Design

- The new interface design appears to work well. Teachers and students are not having difficulty navigating within the Website.

Meeting the Needs of Diverse Learners

2. A teacher noted that her one IEP student is more "on-target" with Exploring Life. Exploring Life appears to be helping him to improve his learning.
3. The Web-based activities need to be written within the developmental range of the target student audience, the middle two quartile students. They can find answers to simple, direct questions. They can also generalize ideas that they glean from the information provided to them.
4. Lower level students will have problems with Webquests or other activities that require multi-tasking. This has been noted in students' reports on the using the Webquests. They report that multiple browser windows on their screen confuse them.

Use of Audio

1. When used appropriately, audio does enhance learning. Exploring Life should not abandon the use of audio. Audio use supports reluctant readers/below-grade-level readers, second-language learners, and visually impaired learners.
2. The use of audio in a video clip can be a powerful learning tool. It is recommended that Exploring Life should provide alternative text for the use of audio in the interactivities. This is standard practice for all material development that are adhering to the WC3 - World Wide Web Consortium recommendations. This can easily be done with hyperlinks to alternative text that summarizes the audio content that is presented in the video clips.

Databased collaborative activities

2. Some participants have noted that the current Exploring Life materials do not contain inquiry-based data sharing activities. These are activities in which students are engaged in a driving question to investigate, collect data with a protocol and then submit their data to a database. The collective data is then shared publicly on the Web where it is displayed in a Web browser or can be downloaded in spreadsheets for students to manipulate to analyze their data to formulate and justify a conclusion.
3. Some participants would like Exploring Life to contain collaborative databased activities and view this as "a natural part of a web-based curriculum."

Homework

- Teacher participants are reluctant to ask the students to use the Website as a homework assignment. They cannot assign something that everyone would not have an equal chance to complete. They are worried about the students who do not have the Web at home.
- Some classroom learners noted they do not have access to email outside of school. However, some of the learners go to the library or to their neighbor's homes to access their e-mail accounts.
- Be cautious about using the Web for homework submissions. Teachers do not want to receive hundreds of email assignments from students every day. Usually, teachers give checks for homework and daily assignments and restrict grading for tests. Keep in mind how much they will actually use if they have to grade it.
- The US Dept of Ed report *The Condition of Education* (http://nces.ed.gov/pubs2001/2001072_3.pdf) shows that 58% of students do 4 or less hours of homework a week. 12% of students do not do any homework at all and an additional 6% don't choose to complete homework.

- If you were to include homework as an extra with Exploring Life, you would have to be sure that it could be accomplished in less than an hour a week in order for the teachers were to use it. Students do at least 4 courses per semester so that is less than one hour a week for homework in any one subject.
- In order to accommodate the general bio students, homework would have to be at a low-level of reading with simple, clearly written assignments. Alternative methods of reporting, verbal reports, projects, etc. would also be beneficial because they would not have to add writing onto the extra reading. There is a direct correlation to homework and reading. Upper level students do more homework. The inability to read, or read well, may be one reason students do less homework.

Chapter 36 findings

- Activities generally are too long.
- Lots of conceptual problems with 36.2 climate and global patterns. The students do not understand the concepts being presented.
- The Webquest contains too much reading and information seeking. Low and mid level readers are having difficulty with this activity.
- The students liked 36.1 but the value / work ratio was off.
- Learners enjoyed reading the text.
- Learners liked the climatographs.

Appendix A. Post Implementation Survey

I. Using the Likert scale below, please indicate to what extent you agree or disagree with the following statements.

1	2	3	4	5
Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree

- The Exploring Life materials promote constructivist learning in the biology classroom.
- The Exploring Life materials encourage active learning for all students.
- The Exploring Life materials did not improve my students' understanding of fundamental biological concepts.
- The Exploring Life materials helped to increase my students' self-confidence in and skill in scientific reasoning and inquiry.
- The Exploring Life materials enhanced my students' ability to apply biological knowledge and the methods of science to important social issues.
- The Exploring Life **teacher support** materials assisted me in implementing the materials in my classroom.
- Inquiry is the basis of the learning experience with the Exploring Life materials.
- The topics of the Exploring Life chapter and the modes of instruction are developmentally appropriate for my students.

II. Open-ended questions. Please respond to the questions below.

- How do the Exploring Life materials help you implement constructivist learning in your biology classroom(s)?
- Which Exploring Life materials promoted active learning of biology?
- How did the Exploring Life materials improve your biology students' understanding of fundamental biological concepts?
- How did the Exploring Life materials improve your students' self-confidence and skill in scientific reasoning and inquiry?
- How did the Exploring Life materials enhance your students' abilities to apply biological knowledge and the methods of science to important social issues?
- How did the teacher support materials assist you with implementing the Exploring Life materials in your classroom?

- How is inquiry the basis of the learning experience with the Exploring Life materials? Provide a few examples.
- How are the topics of the chapter and the modes of instruction developmentally appropriate?

Appendix B. Web-Based Journal

Number of classroom days you used the chapter materials.

Length of classroom period in minutes.

Amount of time (in days) students are in front of computers

Whole class demonstration

One student using one computer

Group using one computer

Learning station or activity centers use

Other _____

Method of instruction. Please assign a percentage to your use of the Exploring Life chapter materials in your classroom. For example, for 90%, enter 90.

Lecture

Hands-on activities

Discussion

Demonstration

Other _____

Other _____

Which Exploring Life activities did you use in your classroom?

Which Exploring Life activities did you not use with your students?

Describe in detail why you did not use these activities?

Briefly describe other activities you used with the Exploring Life materials?

Why did you incorporate these materials?

Describe the assessments you used.

Describe in detail your students' reactions to the Exploring Life materials.

Appendix C. Exploring Life Year 1 Participant Demographic Information

- Region

Plains District: NE, SD, ND, IA, MO, KS, CO, WY, AK	3
New York District: NY state and city	2
New England District: MA, CT, RI, NH, ME, VT	3
MidAtlantic District: NJ, PA, DE, MD, DC	6
Piedmont District: VA, KY, TN, NC, WV	5
Southern District: FL, GA, SC	3
Texas District: Texas	1
Southwest District: NM, OK, LA	5
SouthCentral District: AR, AL, TN	2
California District: California	1
Mountain District: WA, OR, AZ, UT, NV, ID, MT, HI, Guam	7
Mid-America District: IN, OH, IL	2
Great Lakes District: MI, WI, MN	3

- Position

pre-service teacher	1
teacher	40
science supervisor	2

- School characteristic

Rural	12
Suburban	18
Urban	12

- How many years have you been teaching?

1-3	3
4-6	2
7-10	6
11 or more	31

- Do you use the computer at least once a week for teacher planning/preparation?

Yes	41
No	1

- How many years have you been using the Internet for teacher planning/preparation?

not at all	0
less than 1 year	1
1-2	4
3-4	21
5 or more	16

- Please indicate how much you utilize computers/internet to accomplish the following teaching tasks.

	Not at all	A little	A lot
a) Create instructional materials (i.e., handouts, tests, etc.)	0	9	33
b) Gather information for planning lessons	0	12	30
c) Multimedia presentations for the classroom	7	21	14
d) Communicate with colleagues/other professionals	1	10	31

- In your opinion, how well prepared are **you** to use computers and the Internet for classroom instruction?

Not at all prepared...1	0	Somewhat prepared...2	7
Well prepared...3	11	Very well prepared...4	24

- To what extent have each of the following prepared **you** to use computers and the Internet?

	Not At all	Small Extent	Moderate Extent	Large Extent
a) College/graduate work	11	16	8	7
b) Professional development • activities	3	8	11	20
c) Colleagues	2	5	19	16
d) Students	5	17	12	8
e) Independent learning	0	1	11	30

- How many hours of formal **professional development in the use of computers and the Internet** did you participate in during the last 3 years?

0 hours	2
1-8 hours	8
9-32 hours	18
More than 32 hours	14

- Does your school or district require technology training for teachers?

Yes	24
No	18

- Do you have a computer support person to assist you in implementing instructional technologies into your classroom curriculum?

Yes, within the school	26
Yes, within the district	11
No	5
Don't know	1

- School Internet Connectivity

Dedicated line (T1,T3, cable, ISDN, etc.	39
Dial-up modem	0
Don't know, but pages load fast	3
Don't know, but pages load slow	0
Other	0

- How many computers (including laptops available on a daily basis) are located in your classroom?

1 computer-	9
2 computers –	7
4 computers–	1
5 computers–	4
6 computers–	3
8 computers–	1
9 computers–	3
10 computers –	2
12 computers –	3
14 computers–	3
15 computers–	2
18 computers–	1
20 computers –	1
26 computers–	1
32 computers -	1

- How many of the computers located in your classroom currently have access to the Internet?

0 computers– 4

1 computer– 11

2 computers– 3

3 computers- 2

5 computers– 3

6 computers– 2

7 computers– 2

8 computers– 2

9 computers– 1

10 computers– 2

12 computers– 3

14 computers– 3

15 computers– 2

18 computers– 1

26 computers - 1

- Which setting best describes the student/computer ratio in your classroom?

no computers in the classroom, students use a computer lab 2

only a teacher's computer in the classroom, students use a computer lab 16

at least 1 computer for every 4-6 students 8

at least 1 computer for every 2-3 students 14

1 computer for every student (1:1 ratio within the classroom) 2

- Are the following available to **you**, and if yes, to what extent do you use them?

	Available		If available, extent of use			
	yes	no	Not at all	Small extent	Moderate extent	Large extent
a) Computers in your classroom	38	4	2	12	9	17
b) Computers elsewhere in the school (e.g., library, computer lab)	41	1	1	3	15	23
c) Computers at home	40	2	0	5	15	19
d) Internet in your classroom	38	4	3	7	4	27
e) Internet elsewhere in the school (e.g., library, computer lab)	42	0	1	4	6	31
f) Internet at home	39	3	0	5	16	18
g) E-mail at school	41	1	1	2	6	33

- To what extent do you assign **students in your typical class**, work that involves using computers or the Internet in the following ways?

	Not At all	Small Extent	Moderate Extent	Large Extent
a) Practice drills	19	18	5	0
b) Solve problems/ data analysis	3	21	14	4
c) Use computer applications such as word processing, spreadsheets, etc.	0	13	17	12
d) Graphical presentation of materials	2	17	17	6
e) Demonstrations/simulations	5	14	15	8
f) Produce multimedia reports/projects	5	14	15	8
g) Research using CD-ROM	8	20	10	4
h) Research using the Internet	0	5	18	19

- On average, how frequently do **students in your typical class** use each of the following during class time?

	Not at all	Rarely	Sometimes	Often
a) Computers in the classroom	6	10	12	14
b) Computers in a computer lab or library/media center	3	8	23	8
c) Internet from the classroom	9	8	15	10
d) Internet from a computer lab or library/media center	4	8	23	7

- Please indicate to what extent, if any, each of the following are barriers to your use of a Web-based basal biology curriculum.

	Not a barrier	Small barrier	Moderate barrier	Great barrier
a) Not enough computers	23	7	8	4
4. Outdated, incompatible, or unreliable computers	30	8	2	2
5. Internet access is not easily accessible	37	5	0	0
6. Inadequate training opportunities	24	15	3	0
7. Lack of release time for teachers to learn/practice/plan ways to use computers or the Internet	19	9	12	2
f) Lack of administrative support	31	10	1	0
g) Lack of support regarding ways to integrate telecommunications into the curriculum	32	9	0	1
h) Lack of technical support or advice	26	11	5	0
• Lack of time in schedule for students to use Computers in class	17	15	10	0
• Concern about student access to inappropriate Materials	25	13	3	1
k) Lack of funding	10	17	12	3

- Which of the following sources is the **most** influential in guiding your biology instruction in your classroom?

___15___ Teacher generated activities
 ___2___ Textbook
 ___9___ State core curriculum
 ___6___ School/district curriculum
 ___9___ National standards

___1_ Professional education networks

- Which of the following sources is the **second** most influential in guiding your biology instruction in your classroom?

___12_ Teacher generated activities

___4_ Textbook

___9_ State core curriculum

___8_ School/district curriculum

___6_ National standards

___3_ Professional education networks

- Which of the following sources is the **third** most influential in guiding your biology instruction in your classroom?

___7_ Teacher generated activities

___13_ Textbook

___2_ State core curriculum

___4_ School/district curriculum

___9_ National standards

___7_ Professional education networks

- How were you informed about this workshop?

Biopi-l, WWWEDU, Scuttlebutt, or AETS e-mail listserv 3

State science e-mail listserv 6

Personal contact by colleague 11

Secondary contact/forwarded information 17

Personal contact by EL evaluation team 5