

Exploring Life NSTA 2000 Workshop Report

April 24, 2001

Methodology

Fifteen participants attended the Exploring Life NABT 2000 workshop in St. Louis, Missouri on March 23, 2001.

Prior to the evaluation workshop, participants received the following items:

- Exploring Life Prospectus
- Biology: Exploring Life Chapter 7
- Biology: Exploring Life Chapter 8
- Exploring Life Web Site Walkthrough Guide

The Walk-through guide instructed each participant to read the chapters, handouts, and activities on the Website, i.e. the WebQuests, Laboratory, and the Explore! Activities.

Participants were first given an introduction to the evaluation team and the goals and objectives of the Exploring Life teaching materials. Prior to reviewing the materials, participants were asked the following questions to guide their evaluation:

- 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?

Color print copies of the text chapters were provided to each participant.

Participants then reviewed the Web-based interactivities for 1.5 hours. Program evaluators collected participant observations as the teachers interacted with each other and the materials.

Participants then completed a survey (Appendix A) that addressed the main formative evaluation questions stated in the NSF grant proposal.

Finally, a focus group was conducted. A complete list of the questions is listed in Appendix B.

Findings

Met Important Goals of Biological Science Teaching and Learning

Fourteen of the fifteen participants (93%) stated that the Exploring Life materials do address the important goals of biological science teaching and learning.

Specific examples that were mentioned in the survey include:

- Students take an active role in learning the key concepts.
- Make connections to the real world-- What does cell respiration have to do with me (a 15 yr. old)? [i.e. skater & fast food].
- The transfer of energy and how this is accomplished through photosynthesis and cellular respiration.
- Addresses flow of energy through living systems... a primary science standard of NSES.
- It uses different methods of teaching to reach students.
- Provides continuum of events, not merely snapshots, with application to bigger picture.
- Critical thinking is addressed.
- It handles difficult concepts in a very user-friendly manner. (ex. concept 7.6 fermentation)

Three participants stated in their responses that Exploring Life presents more details than is necessary for general level biology:

- Well, in Oregon, our state standards don't require nearly so much detail as what I've seen in chapters 7& 8 so far. Students need a general understanding of cell processes but not the biochemistry details.

Inquiry-Based Activities

Most participants (80%) named at least one Exploring Life activity that they would characterize as "inquiry-based." Nine participants (60%) noted one or more laboratories that they would characterize as inquiry-based.

Caution The survey results are to be taken with some caution. In the focus group it was found that participants were not all using the same definition of inquiry. After we read the National Science Education Standards definition, they were not able to give as many examples. This is significant because the activities may not score as well on a test like the AAAS survey or the AIBS instrument as they scored on our written survey.

Appendix C is a useful tool that the developers may use as they design inquiry activities.

Survey

Activities that were mentioned in the survey as inquiry included:

- Laboratory investigations (6)
- Photo Finish lab (5)
- Cellular Respiration Fastplants lab (4)
- Webquests (4)
- Burning Peanut Lab (3)
- Explore! (3)
- Chromatography demo (2)
- Respiration pinball (2)
- Marshmallow burning (2)
- Fermentation (1)
- Chemical Energy Stored in Food (1)
- Electrons "fall" from food to oxygen (1)
- Animated graphics (1)
- Closer look sections (1)

Two participants responded to this survey item by first defining inquiry as being learner-centered although they could not provide examples from Exploring Life:

- If inquiry-based means showing an event or a discrepant event and students pose their own questions and hypothesis, predict, design, conduct, analyze & conclude--- then none.

- That depends on the way you define inquiry- I see no part of which the student is self-directed or can ask questions... Extensions?

One participant commented that "more user directed manipulation is necessary. I would like to see more options for students' choice on things to do or use."

Participants recommended that the Web-based interactivities could become more inquiry by:

- Providing students with guiding questions before they interact with the Web-based interactivities, and
- Having students formulate predictions before they interact with the Web-based interactivities.

Focus Group

During the focus group, participants were provided with the following definition of inquiry:

"Students formulate questions and devise ways to answer them, they collect data and decide how to represent it, they organize data to generate knowledge, and they test the reliability of the knowledge they have generated. As they proceed, students explain and justify their work to themselves and to one another, learn to cope with problems such as the limitations of equipment, and react to challenges posed by the teacher and by classmates. Students assess the efficacy of their efforts--they evaluate the data they have collected, re-examining or collecting more if necessary, and making statements about the generalizability of their findings. They plan and make presentations to the rest of the class about their work and accept and react to the constructive criticism of others."

When asked, "which activities describe that process?" the participants noted the following:

- The Wisconsin FastPlants lab involved students in an experimental design in which they formulated their own questions to investigate and designed an experimental procedure.
- The Explore! Effects of Increasing Carbon Dioxide Levels asks students to design an experiment showing how carbon dioxide increases plant growth. Learners are provided with a question and are asked to design their own experiment.
- The CalorieQuest can be used as an inquiry activity.

Some participants stated that their conception of inquiry involves “the kids asking questions.”

Many of the inquiry activities on Exploring Life are actually “directed learning.” Many interactivities contain elements of partial guided inquiries. A participant noted this in his survey response: “One could argue that the peanut lab and photosynthesis lab also are [inquiry-based], but there the question and procedure are given.”

Some participants stated that it is important that the inquiry activities in Exploring Life not be entirely materials-centered, but more learner-centered. The Exploring Life materials should not provide the learners with all the necessary components to complete an inquiry. Furthermore, it was noted that inquiries should not take the form of “recipe-like” laboratories with known outcomes.

Participants noted that some activities and interactive animations could be further developed to contain elements of inquiry. Examples provided by the participants included:

- Concept 8.2, page 3 interactivity - Providing questions for students to formulate explanations as they observe the animation: *What are those colors? Why do you have 4 patterns? Why does the green one move first?*

Active Learning

Each participant listed Exploring Life activities that involve active learning because the students were physically and mentally involved in the activities.

The following were specifically listed in the survey responses:

Laboratories	Web activities	Other
Laboratory investigations (6)	All Web-based activities (5)	Quizzes/feedback functions (3)
	Explore! (5)	
	Interactive Animations (4)	
	Webquests (4)	
	Respiration pinball (4)	
	Marshmallow burning (3)	
	Drag and drop interactivities (2)	
	The color of light on plants (1)	
	Plot the data (1)	
	Calculating the calories (1)	
	Cycles (1)	

Specific comments included:

- It appeared to me that all involved active learning- the more engaging ones involved clicking and dragging more often, with less sit and watch.
- I think all of them do. In each activity the student must manipulate something.
- Any of the activities that require the student's input.
- Really, since it is on-line and they are questioned throughout, the concept sections could also be "active."

Use of Animations for laboratory procedures

Most participants (93%) stated that the animations did help them to understand the laboratory procedures. They believed the animations would help students to understand the molecular processes that occur during the laboratory and also to help with setting up the equipment.

One participant was confused by the animations since she was unable to see an entire visualization on her computer screen.

One participant noted that the visualizations could be improved.

The participants provided the following examples how the animations could help learning:

- The animations of the respirometer. It shows what the students should look for.
- Seeing pictures of lab procedures/set-ups helped make labs more realistic (visual vs. just text).
- Chromatography- shows the actual set up, safety features, making the respirometer for seedlings was very descriptive.
- In the micro-respirometer animation, you switch back and forth between (mix and match) ball and stick with nomenclature (K_2CO_3).
- How to glue the tip on the syringe and how to get the disks to sink.
- Respirometer set-up (much more clearly understood w/ diagrams).
- It helped to see the process happening. They are quite complex in this chapter, but you can watch them over and over.
- The animation on lab 7.2 explains well the measuring of respiration!

Assessment

The participants recommended providing a variety of different kinds of assessments with Exploring Life.

Survey responses included:

Traditional	Authentic	Miscellaneous
Traditional end of the chapter test/quiz (n=5)	Performance-based assessments/student-initiated projects (n=3)	Periodic quizzes after each 1-2 concepts (n=1)
Laboratory reports (n=3)	Poster presentations/mini-poster (n=2)	Essays (n=1)
Online review quiz (n=3)	Open-ended component - end of the unit (n=1)	Rubrics (n=1)
Questions at the end of the chapter text (n=1)	Laboratory practicals (n=1)	Simple thumbs up for general concepts (n=1)
Explore! responses (n=1)	Student-created multimedia presentations (n=1)	Students responses via embedded e-mail submission (n=1)
Webquest responses (n=1)	Concept mapping (n=1)	Processing questions - relating one problem to another (n=1)
	Portfolios (n= 1)	Web search/ scavenger hunt (n=1)
	"What ifs" for check on knowledge in cycles-diseases/disorders involved (n=1)	
	Journals (n=1)	
	Critical thinking questions (n=1)	

Comments from participant observation interviews included:

- Open-ended questions.
- Explore! Questions are a type of assessment. If a kid does something, it is actually an assessment.
- Lab reports that illustrate knowledge of experimental design and how to analyze observations.
- Student created artifacts such as PowerPoint presentations, brochures, newsletters. – with rubrics.

Activities for Regular Level Students

All participants stated they could use most of the activities with their regular level biology students. The teachers liked that they had sufficient material that allowed them to make a choice about how much detail they would use.

Seven participants (46%) stated on their survey responses they would **not** go into the specific details of the individual steps of cellular respiration and photosynthesis presented in the chapter with their general level biology students. This was confirmed in the focus group. However, many participants noted they liked that the teacher could decide on the appropriate level of detail for their learners.

Time constraints

Because they would take too long to complete, four participants said they would not use certain activities with their regular level biology students. The activities they would omit were the Explore! And Webquest activities. One participant recommended that Exploring Life provide the opportunity/flexibility to have some of the labs be simulations that she believed would take less time.

One focus group participant noted that she would most likely **not** implement long-term research projects or all the parts of the Explore! activities due to time constraints. She wanted to make sure that the required content is covered for a "high-stakes" end of course test. This participant was concerned about her accountability to her school district's end of the year achievement test. Teachers are receiving more and more pressure from their school administration for their students to achieve high scores on these standardized measurements.

The following are descriptions of activities participants would **not** use with their regular level students due to the high level of difficulty or too many details.

- Too much detail with the photosynthesis & cellular respiration with Biology I students.
- The Closer Looks would not be appropriate for most of my students. I feel the material is too hard for them. They would be confused rather than enlightened.
- Concept 7.4 (too confusing and detailed).
- Concepts 8.2 and 8.3 too hard.
- Krebs cycle and glycolysis are too difficult for standard biology (but if I had time, I would still want to use it to enrich the kids)
- Details of the Krebs or Calvin cycle. I don't feel it's relevant.
- De-emphasize the biochemical pathway detail; present it as an overview. Concentrate on the flow of energy (sun→ producer→ consumer→ ATP) and subsequent cycling of materials. (CO₂, H₂O, sugar & O₂).
- Electron transport chain.
- Light reaction and Calvin cycle.

Website Navigation

Participants stated that the interface was good. Most participants did not have problems moving around within the Exploring Life materials except for some participants who had difficulty returning to the Table of Contents or navigating from one chapter to another. These participants were unable to locate the main chapter index page.

A few participants did not realize they were on an external Website using a Webquest. They clicked the "Back" button when they got lost. On one of the pages it stated in a red font that they would to return to the story but nothing happened when they clicked. These participants experienced confusion trying to get back to the Exploring Life Website from the external site.

Integration Between Text and Website

The interaction between the text and the Website is perceived by the participants as a major strength of Exploring Life. It was noted that the Website simplifies the biological concepts and presents real-life examples and applications of the concepts.

Help lower level students

Most participants (83%) stated that the interactivities and graphics on the Website would help lower level students and low level readers understand the main concepts.

Less threatening to students

The integration of sections between the text and the Website is perceived by the teachers to be less threatening and less intimidating than using a textbook chapter alone. The chapters are broken down into manageable sections for learners. Many participants further commented that such division of the chapter would motivate their students to read more.

Book as reference

Participants foresee using the textbook as a reference material.

A participant noted that ChocolateQuest illustrated a good connection between photosynthesis and respiration by showing to students a manufacturing process that they most likely had never seen before.

Teacher Use of the Exploring Life Program

Order of content and teaching strategy

The participants stated that the order of using the text or Website materials would not make a difference in how students learn. The participants felt that learning could be achieved in either order. Many commented (in focus group and in survey responses) that they look forward to trying out different ways of using the materials in the forthcoming school year and finding out from their students which way works best. One teacher noted that she might give students a choice to how they would use the materials:

"I would do both- 1 computer to 4 students- so I would probably use the presentation (teacher) computer to introduce and get interest, then have half read textbook & half use the computer... then reverse."

Material they would cover

The participants stated that they would **not** cover all the content presented in Exploring Life. Participants noted that they would pick and choose specific major concepts to teach their students.

Use of Webquests

Five participants noted in their survey that they would do the Webquest first. One participant noted she would use the Website as an interactive lecture.

Students who have difficulty reading

Participants noted that the Website materials would benefit students who have difficulty reading.

"Some of my students can't read at that level. I didn't find the text necessary at all. It would be great for those students that like to read, but frankly it is a big fight to get any of them to read. I need to make it possible for students to pass the class without reading. It is a required class and I have to get a majority of them through it successfully."

Additional Positive Comments about Exploring Life

The following comments emerged from the participant observations and the focus group:

- 13 of 15 participants stated they would use the Web components with **lower level students** and readers.
- Many participants expressed positive remarks about the **bear animations**.
- "I know that one thing that I really like about the Website is that it seemed to pull the most **important concepts and it simplified them** even though the reading level I do not think was too difficult in this part, but it broke you down to basics. I really liked that."
- "Another reason that the book and the site go so well together is that its **less threatening**, I believe, if you have it in that small amount and the kids are more likely to say, "I can handle this little thing," and go on to the Website and then see that it interacts so well. I think that would motivate them to read it more. Which is one of the major problems that we are facing in education anyway.
- "I mean, to me it was interactive, **it got their interest**, there were fun things going on."

- “I looked at the Web as this is the **real-world connection** to this book I am supposed to read.”
- “The one thing, they were talking about the **biochemical pathways**. I would like to see them left in. **When you have animations and show what is going on that is much better than seeing them static in a text book**. And that is one thing that I really liked as far as having it on the Web.”
- “The animation in section 8.3 is awesome. It has **good speed**, is broken down in steps and it is not drowned out by a busy background. I really feel this is an animation that should **serve as a model** for future ones to come.”
- Many participants expressed positive remarks about the **quizzes**. They liked how graphics were used.

Participant recommendations for Exploring Life

The participants recommended a variety of improvements for Exploring Life. These include:

- 14 of 15 participants would prefer to have a **modular book** (4 sections) instead of one large book.
- Provide a better **grade management system** to provide feedback to students. When students submit their answers, they can receive their scores and immediate feedback. Eliminate having the teacher manage multitudes of e-mail submissions from their students.
- Use **more sound** with the Exploring Life Website materials. Provide auditory cues with the animations.
- **Decrease details of biochemical pathways** (such as the intermediate products) in the animations. **Provide alternatives** with less emphasis on details and more emphasis on the big picture concepts.
- **Provide more options** for other activities for students to **explore concepts in greater depth**. These include research projects, design projects, and physical modeling activities.

- **Provide additional assessments** for students to demonstrate content that are beyond answering multiple-choice questions. Provide learners with opportunities to write and display critical thinking skills.
- Make Exploring Life a **flexible curriculum** that provides teachers the opportunity to pick and choose themselves the amount of depth to teach the concepts.
- Provide more **user control** over the speed of the pinball animations. It was recommended to have more user control to isolate parts of interactivity and look at each stage separately.
- Provide **secure quizzes and tests** on the Website that would require a password for student access.
- Provide a **flexible type of rubric** that will help teachers to develop their own rubrics for activities.
- It was suggested that Exploring Life have a "**media toolkit**" for teachers to use. The curriculum could provide raw multimedia materials (such as JPEGs) for teachers to create PowerPoint presentations.
- **Use Web-based simulations** for students to **vary factors of labs online**. Students should be able to use the computer to manipulate the data. This type of feature would make Exploring Life more interactive.
- In the text at the end of chapter, **place "Critical Thinking" before the Concepts**. This will make the product different than other texts and will emphasize more critical thinking skills.
- Presenting learners with background knowledge before they interact with the 7.5 cellular **respiration pinball**.
- When a learner takes the quiz and goes to an area of Exploring Life for review, he/she needs to be able to click to the "**Back Button**" in the Web browser to return to the Quiz. Furthermore, the answers need to be kept on the Quiz when the learner returns to it.

- In the laboratories, create an interface that would **generate a graph** online as students plot their data.
- Write a statement to the students about how **to close the pop-up windows**.
- Provide a statement in the Teacher Resource section that provides an **estimated length of time to complete the Webquests**.
- Provide **hard copies of Teacher Guides** for the labs. Also, provide transparencies.
- **Concept 7-6, Question 2** does not provide the number of ATPs after the answer is submitted.
- Create more labs such as Photo Finish that involve **little equipment**.
- **Critical thinking** is only at the end of the assessments. It needs to be placed throughout the chapter.
- Create **smaller quizzes** integrated throughout each chapter in addition to having one quiz at the end.
- Increase the **use of graphics** in the end of the chapter quiz.
- When students receive an **incorrect answer**, direct them back to a Web page where they can relearn the concept.
- Create a Web page that contains **links to all plug-ins and helper applications** that one would need to download and install for Exploring Life.
- **Chapter 8, ChocolateQuest, Question 2c** is a statement. This should be changed to an appropriate question, or be removed.

Participant Concerns about Exploring Life

- A few participants commented that some concepts are presented in greater detail than may be appropriate for regular level students.
- Audio is not provided for the auditory learners.
- Many participants were uncomfortable with students e-mailing responses to the teacher. In the peanut calorie lab, the teacher would receive e-mail three different times. Participants expressed concern about organizing large quantities of e-mail.
- Ch. 7, Lab 2, P. 3 - There are interface issues with scrolling down the page to see the glue gun. Press the glue gun [Start button] and you can not see the animation on iMac computers. The syringe needs to be placed closer to the glue gun. Otherwise, students will not see the animation.
- The cellular respiration lab is what is normally done with AP classes. A participant commented that she was apprehensive about having her students use this lab with general level kids. Would a simulated lab be provided?
- One participant commented that some concepts were omitted in the chapter materials: "Concept 8.2; This process is "chromatography" but I didn't see it mentioned. The color key represents different pigments, but I didn't see this mentioned either."

Appendix A. NSTA Survey questions

What textbook curriculum do you currently use in your biology classroom?

Do the Exploring Life materials address the important goals of biological science teaching and learning? Yes or No Give two examples of your reasoning.

List the *Biology: Exploring Life* activities would you characterize as being **inquiry-based**?

List the *Biology: Exploring Life* activities that involve **active learning**?

Did the animations help you understand the laboratory procedures?
Give one example of how they helped.

List the kinds of student assessments you would recommend and where would you use them.

List the *Biology: Exploring Life* activities would you **not** use with regular level biology students and give an example why; for example; not enough time, material too hard or too easy, etc.

Should students use the Web components prior to reading the text or read the text prior to using the Web components? List examples how you might order the activities in class.

Appendix B. NABT Focus Group Questions

The National Science Standards describe inquiry as follows:

Inquiry Students formulate questions and devise ways to answer them, they collect data and decide how to represent it, they organize data to generate knowledge, and they test the reliability of the knowledge they have generated. As they proceed, students explain and justify their work to themselves and to one another, learn to cope with problems such as the limitations of equipment, and react to challenges posed by the teacher and by classmates. Students assess the efficacy of their efforts--they evaluate the data they have collected, re-examining or collecting more if necessary, and making statements about the generalizability of their findings. They plan and make presentations to the rest of the class about their work and accept and react to the constructive criticism of others

Which activities describe that process?

- Give an example of an activity that is inquiry.
 - How can non-inquiry activities be made into inquiry-based activities?
 - Does your district or school standards require inquiry activities?
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- One of the project's goals is to provide a seamless integration between the text and the Web – please comment on that. To what extent was that achieved? Do you have suggestions for improving that?
 - How would you use Exploring Life materials for your general biology students (not honors biology students)?
 - What obstacles would you have (if any) to using this product in your school?
 - If you were going to give the developers one piece of advice going forward, what would it be?