GOODMAN RESEARCH GROUP, INC.
Program Evaluation • Consultation • Market Research

Formative Evaluation of the Economic Botany Curriculum

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INTRODUCTION

In January 2006, Goodman Research Group, Inc. (GRG) contracted with New York Botanical Gardens (NYBG) to conduct a formative evaluation of their Economic Botany Curriculum. The curriculum is being developed by Education Development Center (EDC) for NYBG as a follow-up to the first unit of the curriculum, Ethnobotany, for which GRG also provided formative evaluation. Economic Botany is a three to four week curriculum that teaches middle school students about the relationship of botany to economics. The curriculum is divided into 11 individual lessons:

- Lesson 1 – Who Planted the Evidence
- Lesson 2 – Making a Plant Concept Map
- Lesson 3 – Flower Autopsy (pollination)
- Lesson 4 – Fruit Autopsy (seed dispersal)
- Lesson 5 – The Case of the Vanishing Stingless Bee
- Lesson 6 – Commercially-Valuable Crops
- Lesson 7 – Myanmar Mystery
- Lesson 8 – Rice Crop Rescue
- Lesson 9 – Grain of Truth
- Lesson 10 – Refining the Concept Map
- Lesson 11 – Student Research Project Designs and Mystery Mixture Activity

Each lesson is designed to take one to three 45-minute sessions. Students often work in groups and conduct hands-on experiments as they learn about Economic Botany.

The primary goal of the formative evaluation was to obtain information that would support and guide EDC as they modify the existing lessons. GRG assessed the use of, clarity, appeal, usability, response to, and comprehension of lessons by teachers and their impressions of how students responded to the lessons.

METHOD

In January 2006, GRG used their online database to recruit seven middle school science teachers to participate in the study. Teachers were sent an email with information about the study and compensation for their time, and were asked to respond if they were interested. Approximately 15 teachers indicated they were interested in participating in the study. GRG, in consultation with NYBG, then selected seven teachers who represented a range of geographic locations, school settings, and grades taught, to participate in the study.

In February 2006, NYBG emailed GRG a link to drafts of the Economic Botany lessons. GRG assigned teachers between two and ten lessons to use with at least one of their classes. Lesson assignments depended on the amount of time teachers had available, length of the lessons, and whether or not lessons were meant to be used together. Because Lesson 10 was similar to Lesson 2, it was not assigned to teachers.

GRG sent teachers their assigned lessons via email attachments in February 2006 and asked teachers to spend approximately three weeks reviewing the lessons and preparing to use them with their students. While teachers were reviewing their assigned lessons, GRG developed an online Pre-Survey, Lesson Feedback Survey, and Post-Survey to collect teachers' feedback. GRG emailed the teachers with instructions and links to these surveys in March and instructed them to complete the Pre-Survey upon receipt of the message. The Pre-Survey was designed to measure the following:

- Grade levels and subjects taught
- Past experience teaching science and botany
- Demographic information about teacher and students

Teachers were given approximately five weeks in March and April to use their assigned lessons. They were instructed to complete an online Lesson Feedback Form immediately after completing each lesson. The Lesson Feedback Form was designed to measure the following:

- How much time teachers spent using the lesson
- Which parts of the lesson were used
- How the lesson was used
- Opinions of the lesson
- Student reactions to the lesson
- Suggestions for improving the lesson

After completing all their assigned lesson, teachers were instructed to complete the Post-Survey, which was designed to measure the following:

- Opinions of the overall curriculum
- Lessons students learned from the curriculum
- Teachers' intent to use Economic Botany in the future
- Additional comments

After teachers submitted all surveys, GRG mailed them a stipend as a token of appreciation for participating in the study and a reimbursement of $25 for supplies they purchased during their use of the lessons. Payments ranged from $225 to $575, depending on how many lessons a teacher completed.

In total, five teachers completed all their assigned lessons and one teacher completed eight of her ten assigned lessons. The remaining teacher did not complete any surveys and did not respond to follow-up inquires from GRG.

RESULTS

Results from the three surveys are presented below. First, a profile of respondents is presented, followed by teachers' use and opinions of each lesson, and teachers' impressions of each lesson's impact on their students. Finally, teachers' opinions of the overall curriculum and comparisons to the Ethnobotany unit are discussed. Because of the small number of teachers surveyed, numbers rather than percentages are used in the reporting of results.

PROFILE OF RESPONDENTS

Background and demographic information about teachers and their schools is presented first in aggregate and then followed by profiles of individual teachers.

Past Experience Teaching

Respondents had been teaching, and teaching science specifically, for two to 18 years, and for 11 years on average. Four teachers teach 6th, 7th, and 8th grade, one teacher teaches 6th and 8th grade, and one teacher teachers only 6th grade. Half the teachers held a Bachelor's degree and half held a Master's degree.

All six teachers currently teach science and four also teach math. Courses listed by the respondents include the following:

Science:

- General Science
- Chemistry
- Biology
- Life Science
- Earth Science
- Physical Science
- Oceanography
- Animal Science
- Physics

Math:

- General Math
- Algebra 1
- Algebra 2
- Pre-Algebra
- Geometry

Two teachers indicated they taught some other subject, including Physical Education and Gifted Studies.

Four teachers responded that they had previously incorporated economic concepts into their science teaching. When asked to explain how they have done this, teachers commented that they had discussed products that could be bought or sold, the cost of materials, and land use. One teacher explained that she incorporated these concepts into problem-solving activities.

As shown in Table 1, time spent teaching botany in a typical school year varied across teachers and ranged from 1 to 2 weeks to an entire year.

Table 1
Time spent teaching botany in a school year

	# Respondents
Less than 1 week	0
1 to 2 weeks	1
3 to 4 weeks	2
5 to 9 weeks	1
One grading period	1
One full semester	0
An entire year	1

N=6

Similarly, the number of hours spent teaching botany in a typical school year varied greatly, ranging from 6 hours to 500 hours. On average, teachers spent 27 hours teaching botany (excluding the one teacher who indicated she spent 500 hours).

School Demographics

Four teachers reported they taught in a public school, one teacher taught in a private, non-parochial school, and one teacher taught in a private, parochial school. One teacher indicated her school was in an urban setting, while two schools were in a suburban setting, and three schools were in a rural setting.

Student Demographics

When asked to rate the socioeconomic level of their student body, three teachers indicated their student body was *mostly lower*, two teachers indicated it was *mostly middle*, and one teacher said it was *mostly upper*.

Teachers were asked to estimate the racial/ethnic composition of the students with whom they work. As shown in Table 2, four teachers worked with primarily white students while two teachers worked with students of many different racial and ethnic backgrounds.

Table 2
Demographics of students

	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6
% American Indian	1%	0%	0%	0%	0%	20%
% Asian	0%	3%	0%	0%	1%	20%
% Black or African American	0%	20%	0%	10%	25%	15%
% Hispanic or Latino/a	20%	14%	0%	0%	35%	10%
% Native Hawaiian or Other Pacific Islander	0%	0%	0%	0%	0%	10%
% White or Caucasian	79%	66%	100%	90%	39%	25%

Individual Teacher Profiles

As shown in Table 3, each individual teacher used a different combination of two to ten lessons with one to three different grade levels. Teachers taught students of various socioeconomic levels in a variety of locations across the country in both public and private schools. Most teachers had been teaching science as long as they had been teaching and most taught both science and math.

Table 3
Individual teacher demographics

	School City, State	School location	School Type	Socioeconomic level of student body	Lessons used	Grade(s) used Lessons with	Years Teaching	Years Teaching Science	Subject(s) Taught
Teacher 1	Midway, GA	Rural	Private, Non-Parochial	Mostly middle	2, 7, 9	6th, 7th, 8th	10	10	Science, Math
Teacher 2	Culleoka, TN	Rural	Private, Parochial	Mostly upper	1-9, 11	6th, 8th	11	10	Science, Math
Teacher 3	Dundee, FL	Rural	Public	Mostly lower	1-8	6th, 7th	2	2	Science
Teacher 4	Eugene, OR	Suburban	Public	Mostly lower	2, 5, 6	6th	18	18	Science, Math, Physical Education
Teacher 5	Belmont, CA	Suburban	Public	Mostly middle	2, 8, 9, 11	6th, 7th, 8th	8	8	Science, Math
Teacher 6	Orlando, FL	Urban	Public	Mostly lower	1, 3	6th	17	17	Science, Gifted Studies

Brief teacher biographies

Teacher 1:

The teacher from Midway, Georgia is currently teaching 6th, 7th, and 8th grade regular and special education classes and used Lessons 2, 7, and 9 with all three grade levels. She holds a Bachelor's degree and has been teaching in general, and teaching science specifically, for 10 years. She teaches science and math courses in Earth Science, Oceanography, Pre-Algebra, and Geometry. She typically spends five to nine weeks each school year teaching botany and has not previously incorporated economic concepts into her science teaching.

Teacher 2:

The teacher from Culleoka, Tennessee is currently teaching 6th, 8th and 10th grade and used Lessons 1 through 9 and 11 with her 6th and 8th grade students. She holds a Bachelor's degree and has been teaching for 11 years and teaching science specifically for 10 years. She teaches science and math courses in Chemistry, General Science, Animal, Botany, General Math, and Algebra. She typically spends one grading period teaching botany and has previously incorporated economic concepts into her science teaching by covering information on the cost of materials and selling and using products.

Teacher 3:

The teacher from Dundee, Florida is currently teaching 6th, 7th, and 8th grade at-risk students and used Lessons 1 through 8 with her 6th and 7th grade students. She holds a Bachelor's degree and has been teaching in general, and teaching science specifically, for two years. She teaches Integrated Science and typically spends three to four weeks each school year covering botany. She has not previously integrated economic concepts into her science teaching.

Teacher 4:

The teacher from Eugene, Oregon used Lessons 2, 5, and 6 with the 6th grade students she is currently teaching. She holds a Master's degree and has been teaching science, and teaching in general, for 18 years. She teachers 6th grade science, 6th grade math, and Physical Education to Special Education, Gifted, and Regular students. She typically spends 3 to 4 weeks each school year covering botany and has previously integrated economic concepts into her science teaching by discussing the relationship between forests and land use development and discussing products to purchase and natural resources.

Teacher 5:

The teacher from Belmont, California currently teaches 6th, 7th and 8th grade and used Lessons 2, 8, 9, and 11 with all three grades. She holds a Master's degree and has been teaching science, and teaching in general, for eight years. She teaches science and math courses in Chemistry, Biology, Botany, Physics, and General Mathematics. She typically spends an entire year covering botany and

commented that she integrates economic concepts into her botany teaching because she feels they are "*very much related*."

Teacher 6:

The teacher from Orlando, Florida is currently teaching 6th, 7th, and 8th grade regular and gifted students and used Lessons 1 and 3 with just her 6th grade students. She holds a Master's degree and has been teaching science, and teaching in general, for 17 years. She teaches Life Science, Earth/Space Science, Physical Science and Gifted Studies and typically spends 1 to 2 weeks covering botany each school year. She has previously integrated economic concepts into her science teaching by using problem solving activities with her science classes. She has also played the "Stock Market Game" with her gifted studies class.

USE OF LESSONS

Overall Use of the Lessons

The following section presents data on how teachers used their assigned lessons, including how many they used, the dates they used them, and whether or not they used them in conjunction with other materials.

Teachers' use of each lesson is shown in Table 4:

- Between two and five teachers used each lesson.
- All 10 lessons were used 6th, 7th, and 8th grade students.
- Teachers used the lessons with each class for 15 minutes to 180 minutes.

Table 4
How lessons were used

Lesson	# of teachers who used lesson	# of classes used lesson with	Time spent on lesson per class	Grades used lesson with		
				6th	7th	8th
1	3	1	30	✓		✓
		1	100	✓		
		1	180	✓	✓	
2	5	1	22	✓		✓
		6	55	✓	✓	✓
		4	60	✓	✓	✓
		1	90	✓	✓	
		2	120	✓		
3	3	1	30	✓		✓
		1	50	✓		
		1	90	✓	✓	
4	2	1	22	✓		✓
		1	90	✓	✓	
5	3	1	30	✓		✓
		2	180	✓		
		1	90	✓	✓	
6	3	1	22	✓		✓
		2	60	✓		
		1	90	✓	✓	
7	3	1	30	✓		✓
		6	55	✓	✓	✓
		1	135	✓	✓	
8	3	1	22	✓		✓
		4	60	✓	✓	✓
		1	90	✓	✓	
9	3	1	30	✓		✓
		6	55	✓	✓	✓
		4	60	✓	✓	✓
11	2	1	15	✓		✓
		4	60	✓	✓	✓

Note: The time presented in the table is the amount of time spent on the specified Economic Botany lesson with each class.

Preparation

This section describes how teachers prepared to use each lesson and includes which resources they used while preparing and how long it took them to prepare.

Teachers were asked to indicate whether or not they had difficulty obtaining materials needed for each lesson they used, and whether they accessed materials from the reference list. If teachers answered "yes" to either of these questions, they were asked to further explain their answer. As shown in Table 5:

- One teacher had difficulty obtaining Brazil nuts in their shells and orchids for Lesson 1 and one teacher could not find two types of vanilla beans for Lesson 6.

- One teacher each accessed the reference materials for Lessons 2, 9, and 11.
- One teacher accessed a Web site and two others accessed books.

Table 5
Use of Materials

Lesson	Difficulty obtaining materials (# Yes)	Accessed reference materials listed (# Yes)	Materials accessed
1	1	0	
2	0	1	Website on concept mapping
3	0	0	
4	0	1	Wayne's Word http://waynesword.palomar.edu/termfr1.htm.
5	0	0	
6	1	0	
7	0	0	
8	0	0	
9	0	1	Library books related to grains
11	0	1	Simpson, Beryl Brintnall and Ogarzaly, Molly Connor. Economic Botany third edition, Plants in our World, McGraw-Hill 2001

Teachers who accessed reference materials were asked to describe how they used them.

- One teacher said they were used as an addition to the class.
- The teacher who accessed reference materials for Lesson 4 used them to clarify terms.
- The teacher who accessed a Web site for Lesson 2 did not find it helpful and did her own search for Web sites on concept mapping. She suggested the following:

I did my own internet search on concept mapping and found a great site that might be good to note in the reference section. http://www.fed.cuhk.edu.hk/~johnson/misconceptions/concept_map/concept_maps.html
I found it helpful to first teach what concept mapping was by using something they already knew before we began this lesson. I picked two topics, "football" and "healthy diets" and the class worked with me to build a concept map together. Although I didn't use it with students, I personally learned more about concept mapping from the graphic on handout 1.

Teachers were asked how long it took them to prepare for each lesson, if the time estimates for completing each lesson were realistic, and if they tried any activities ahead of time, before using them with their class. As shown in Table 6:

- Teachers spent anywhere from 10 minutes to 200 minutes preparing to use each lesson. One teacher consistently indicated that it took her 10 to

20 minutes to prepare each lesson, while most of the other teachers took 60 to 120 minutes to prepare.

- Most teachers did not try activities ahead of time, before using them with their class. Of those who did, one teacher set up the scenes for Lesson 1 ahead of time, three teachers tried to make their own concept map for Lesson 2, and one teacher constructed the map for Lesson 7.

Table 6
Preparation Activities

Lessons	Time to prepare (minutes)	Tried activities ahead of time? (# Yes)	Activities that were tried ahead of time
1	20 45 100	1	Setting up the scenes
2	15 30 60 90 (2 teachers)	3	Made own concept map
3	15 30 (2 teachers)	0	
4	15 30	0	
5	10 15 120	0	
6	15 45 120	0	
7	20 120 200	1	Constructing the map
8	10 20 90	0	
9	10 60 (2 teachers)	0	
11	20 120	0	

Use in Class

Teachers commented on how they used each lesson by describing which parts of each lesson they used, whether they omitted or added material to each lesson, and whether they felt the suggested time estimates were accurate. Responses to these questions are described below.

Content that was omitted and content that should be included

Teachers were first asked whether they omitted any activities while using the lessons and then were asked if there was any content they expected to see included in the lessons, but didn't see.

One teacher who used Lesson 11 omitted the research assignment because it did not fit with her curriculum. She also did not like Handout #3 because she felt students could do research without this type of form. All other teachers used all activities of each of their assigned lessons.

Content that teachers expected to see in each lesson is shown in Table 7:

- Teachers who used Lessons 1, 2, 7, and 8, expected to see other content included in the lessons.

Table 7
Content teachers expected to see

Lessons	Expected other content (#Yes)	Content teachers expected to see
1	1	▪ More about structure and function of plants. Would also like to see writing component.
2	2	▪ More examples of concept maps. ▪ Suggestions of subtopics students could use i.e. recreation, food source, etc.
3	0	
4	0	
5	0	
6	0	
7	1	▪ Pictures of rattan furniture products.
8	2	▪ Specific amounts of yields for crops that decreased ▪ More information in general about the crops ▪ More reference books
9	0	
11	0	

Use with external materials and current curriculum

Teachers were asked if they used external or supplemental reading or activities while using each of their assigned lessons and if they tied activities from the Economic Botany lessons into their existing lessons. If teachers used external or supplemental materials, they were asked to list the materials they used. As shown in Table 8:

- At least one teacher who used Lessons 1, 2, 3, and 11 used external readings or activities.
- Most teachers who used external materials used Web sites or books with more information on plants. One teacher used additional materials for the investigative portion of Lesson 11.

- At least one teacher tied Economic Botany activities to her existing lessons for eight of the ten lessons.

Table 8
Use of external materials and integration into existing lessons

Lessons	Used external reading or activities (#Yes)	External materials used	Tied Economic Botany activities to existing lesson (#Yes)
1	1	▪ Enchanted Learning Web site for identification of structures of plants and fruit	1
2	2	▪ Web site with explanation and examples of other concept maps ▪ Florida's Forests booklet that listed products made from trees	2
3	2	▪ Other plant diagrams with parts listed ▪ Enchanted Learning Web site and plant identification books	1
4	0		2
5	0		1
6	0		2
7	0		0
8	0		1
9	0		1
11	1	▪ Additional plant-based items for investigative portion, such as garlic, oil, etc.	0

If teachers tied the Economic Botany lesson to their existing lesson, they were asked to rate, using a 5-point scale from *Not at all easy* to *Extremely easy*, how easy it was to do so.

As shown in Table 9, of the teachers who tied Economic Botany into their existing lessons,

- Most teachers indicated it was *somewhat* to *very easy* to tie the Economic Botany lessons to existing lessons.
- Lessons 1 and 3 received the lowest ratings with each teacher indicating it was *a little easy* to tie these Economic Botany lessons to existing lessons.

Table 9
How easy to tie Economic Botany activities into existing lessons

Lesson	Not at all easy	A little easy	Somewhat easy	Very easy	Extremely easy
1	0	1	0	0	0
2	0	0	1	1	0
3	0	1	0	0	0
4	0	0	1	1	0
5	0	0	1	0	0
6	0	0	1	1	0
7*	-	-	-	-	-
8	0	0	0	1	0
9	0	0	1	0	0
11*	-	-	-	-	-

* No teachers who used this lesson tied it to their existing lessons.

Accuracy of Time Estimates

Teachers were asked whether or not they felt the time estimates provided in the lesson were accurate and were then asked to explain their response. As shown in Table 10:

- Most teachers felt the time estimates for completing each lesson were realistic. Two teachers took longer to complete Lesson 2 and 7 because their students needed more time to understand the activity.

Table 10
Time estimates

Lessons	Time estimate realistic (# No)	Explanation of why time estimate was not realistic
1	0	
2	2	- Students were frustrated and could not stay on task - One class period for students to build map, one for them to present
3	0	
4	0	
5	1	- Used 1 day to discuss co-evolution and begin project, 1 day to read witness accounts and begin handout, and 1 day to complete handout and read newspaper article.
6	0	
7	2	- Some students needed more time in session 2. - Kids did not understand the idea – took long to explain.
8	0	
9	0	
11	0	

Perceptions of Use

Teachers were asked to rate, using a 5-point scale from *Not at all* to *Extremely*, how prepared they were to teach each lesson they received, how well each lesson met its stated learning goals, and how easy it was to relate the concepts covered in each lesson to real life issues. A summary of results is presented first, followed by the same information, in more detail, with representative quotes and tables. Finally, a summary of open-ended responses is presented.

Summary of Ratings

Overall, most teachers felt *very* prepared to use their assigned lessons based on the lesson plan they received, felt each lesson met the stated learning goals *very* well, and found it *very* easy to relate concepts from each lesson to real life issues. Teachers felt most prepared to use Lessons 3 and 9 and least prepared to use Lesson 2. Teachers also found Lessons 1 and 3 were the easiest to relate to real life concepts.

Teachers only provided suggestions for Lessons 1 and 2; they suggested providing more direction for teachers in Lesson 1 and providing more examples of concept maps for students in Lesson 2, which corresponds to other feedback given by teachers throughout the survey.

How prepared teachers were to use their lessons

As shown in Table 11:

- Most teachers indicated they were *very* prepared to use their assigned lessons based on the lesson plan they received.
- Teachers felt most prepared to use Lessons 3 and 9 because they had done similar activities before and because the lesson plans were easy to follow.

  I have done flower dissections in other classes so this [Lesson 3] *was familiar.*

  It was easy to follow, therefore I was prepared. [Lesson 3]

  Basic science experiment. Had used this in other books. [Lesson 9]

  Based upon the lesson plan, I was extremely prepared to utilize it, as the lesson plan was extremely easy to follow, and complete. [Lesson 9]

- Teachers felt least prepared to use Lesson 2. In other parts of the survey, teachers mentioned that they needed to gather more background information on concept mapping in order to use Lesson 2, which may explain why they felt they were not fully prepared.

Table 11
How prepared teachers were to use their lessons

Lesson	Not at all	A little	Somewhat	Very	Extremely
1	0	0	0	3	0
2	0	1	1	3	0
3	0	0	0	2	1
4	0	0	0	2	0
5	0	0	0	3	0
6	0	0	1	2	0
7	0	0	1	2	0
8	0	0	0	3	0
9	0	0	0	2	1
11	0	0	0	2	0

How well the lessons met their stated learning goals

Teachers rated each lesson regarding its stated learning goals (Table 12):

- Most teachers indicated each lesson met its stated learning goals *very* well.

  The stated learning goals were met, as the students not only worked together within their teams, but also when they presented. [Lesson 2]

The lesson met the stated learning goals very well, by its complete thoroughness of content. [Lesson 7]

The lesson met the stated learning goals very easily, especially in the area of the students developing laboratory skills. [Lesson 9]

Table 12
How well each lesson met its stated learning goals

Lesson	Not at all	A little	Somewhat	Very	Extremely
1	0	0	1	2	0
2	0	0	1	4	0
3	0	0	1	1	1
4	0	0	0	2	0
5	0	0	1	2	0
6	0	0	1	2	0
7	0	0	1	2	0
8	0	0	0	3	0
9	0	0	0	3	0
11	0	0	0	2	0

How easy it was to relate concepts to real life issues

The ratings for ease of relating concepts to real life is shown in Table 13:

- Most teachers indicated it was *very* easy to relate the concepts covered in each lesson to real life issues.
- Teachers felt Lessons 1 and 3 were the easiest to relate to real life issues, as these were the only lessons that received ratings of *extremely*.

Real life issues: students were ready to investigate plants in their own yards. [Lesson 1]

It led to discussions about invasive plants and toxic invaders that are illegally exported and effect the southeast. [Lesson 1]

Lots of real life issues, like do you want the bees that probably pollinate these flowers near your house? If not, do not plant near house. [Lesson 3]

Table 13
Ease of relating concepts to real life issues

Lesson	Not at all	A little	Somewhat	Very	Extremely
1	0	0	0	2	1
2	0	1	1	3	0
3	0	0	0	2	1
4	0	0	0	2	0
5	0	0	1	2	0
6	0	0	1	2	0
7	0	0	2	1	0
8	0	0	0	3	0
9	0	0	1	2	0
11	0	0	0	2	0

Comments and Suggestions about the ratings

Presented in Table 14 are teachers' comments about how prepared they were to use each lesson, how well the lesson met its stated learning goals, and how easy it was to relate each lesson to real life. Because most teachers gave ratings of *somewhat* to *extremely* for these components, more comments than suggestions were provided.

Table 14
Positive Comments and Suggestions for Improvement for Perceptions of Use

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Goals were met. ▪ Students were ready to investigate plants in their own yard. ▪ Led to discussion about invasive plants that are illegally exported and its effect on the Southeast. ▪ Most difficult to prepare – locating items, preparing and having enough reference materials.	▪ Need to add more direction for the teacher to connect ideas between plant parts. Had students write their ideas for what the parts function were and used that as a discussion.
2	▪ Students did a great job with the maps. ▪ It was a good assessment tool. Will use it for other subjects. ▪ Made a chart in front of students and used different shaped and colored post-its to help them understand. ▪ Great hands-on approach to organization of information.	▪ Start by making a map as a class using an idea students are familiar with (baseball game, camping trip, etc.) and then have students make their own map of plants.
3	▪ Had done similar activities before so it was easy to prepare for. ▪ Easy to relate to real life issues – like whether or not students would want plants that bees pollinate near their house. ▪ Not a clear problem stated for the students.	
4	▪ Handouts easy to use. ▪ Easy to implement learning concepts. ▪ Easy to show how flowers become fruit.	
5	▪ Deforestation is a hot topic these days so it was easy to relate to real-life issues. ▪ Easy to relate to species in community and in current science unit.	
6	▪ Lesson plan clear and easy to follow. ▪ The items used are in every kitchen so it was easy to tie into everyday life.	
7	▪ Related activity to a dig for fossils. ▪ Students really got into the detective role. ▪ The content was complete and well organized and met the learning goals.	
8	▪ Students worked well in groups. ▪ This is an issue in the agricultural community.	
9	▪ Easy to prepare as this was an activity found in our other science books. ▪ Because students used their own food, it prompted a discussion about food choices and nutrition. ▪ Lesson plan was easy to follow and complete. ▪ Met learning goals, especially in area of students developing laboratory skills.	
11	▪ Students realized how plants are used in everyday items. Someone has to raise these plants and get paid for them.	

OPINIONS OF LESSON COMPONENTS

Helpfulness of Lesson Components to Teachers

Teachers rated the helpfulness of several components of each lesson they used, using a scale from *Not at all helpful* to *Extremely helpful*. If teachers did not use a particular component or it was not included with their lesson, they could select N/A (*Not applicable*). A summary of results is presented first, followed by the same information, in more detail, with representative quotes and tables. Finally, a summary of open-ended responses is presented.

Summary of lesson components

Overall, teachers found all components of all lessons to be helpful. Most teachers rated each lesson component as *very* or *extremely helpful* and commented that they found the components well organized, clear, easy to read and understand, and easy to implement. Teachers also commented that student handouts were helpful for students and supported the learning goals.

Teachers' ratings indicated that the components of Lessons 2 and 7 were slightly less helpful than the components of other lessons. Some of the teachers who reviewed these lessons rated the components as *somewhat helpful*, compared to *very* or *extremely helpful* for other lessons. Specifically, some teachers commented that students had a hard time understanding the concept map activity in Lesson 2 and would like more examples of concept maps to show their students. For Lesson 7, cutting out the cards was time consuming and teachers would have liked to view the video.

Lesson Overview

Teachers rated the helpfulness of each lessons' overview, shown in Table 15:

- Most teachers rated the Lesson Overviews as v*ery helpful* across all lessons (except for Lesson 2).

  The lesson overview gave me a picture of where I was heading, the plan was succinct. [Lesson 1]

  Lesson well designed. [Lesson 6]

  The lesson overview was very helpful in providing me with a glimpse of what the students will learn and be doing throughout the lesson. It is very self-explanatory, and easy to understand. [Lesson 9]

- The lesson overview was the least helpful for Lesson 2, with three teachers rating it as s*omewhat helpful*.

Table 15
Helpfulness of Lesson Overview

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	0	3	0	0
2	0	0	3	1	1	0
3	0	0	0	3	0	0
4	0	0	0	2	0	0
5	0	0	0	3	0	0
6	0	0	0	3	0	0
7	0	0	2	1	0	0
8	0	0	0	3	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Learning Goals

Ratings of the helpfulness of learning goals for each lesson are shown in Table 16:

- Most teachers rated the Learning Goals as v*ery helpful* across all lessons.

  The "Learning Goals" area of the lesson was very helpful in that it provided specific goals for the students to achieve in an interwoven fashion. All of the goals were very well inter-linked together, and the students were able to observe this upon completion of their goals. [Lesson 7]

  Lesson plans and goals well stated and easy to implement. [Lesson 9]

- The Learning Goals in Lesson 2 were rated the lowest, with two teachers rating them as *somewhat helpful*.

Table 16
Helpfulness of Learning Goals

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	0	2	0	1
2	0	0	2	2	1	0
3	0	0	0	3	0	0
4	0	0	0	2	0	0
5	0	0	0	3	0	0
6	0	0	0	3	0	0
7	0	0	1	2	0	0
8	0	0	0	3	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Materials/Equipment

Table 17 displays teachers' ratings of the helpfulness of materials and equipment:

- Most teachers rated the Materials/Equipment list as v*ery helpful* across all lessons.
- The Materials/Equipment list for Lessons 1 and 2 was rated the highest, with two teachers rating it as *extremely helpful* for these lessons.

  List of materials very specific. I did not have to read the entire lesson to determine what materials were needed. Good list. [Lesson 1]

  No materials needed. An easy lesson in regards to out-of-class materials. [Lesson 2]

- The Materials/Equipment list was rated the lowest for Lesson 7, with all three teachers rating it as *somewhat helpful* for this lesson.

  Cutting out cards time consuming. [Lesson 7]

Table 17
Helpfulness of Materials/Equipment

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	0	1	2	0
2	0	0	1	2	2	0
3	0	0	0	2	1	0
4	0	0	0	2	0	0
5	0	0	0	2	0	1
6	0	0	0	3	0	0
7	0	0	3	0	0	0
8	0	0	0	2	0	1
9	0	0	1	1	1	0
11	0	0	0	2	0	0

Preparation

The preparation section for each lesson was rated by teachers, as seen in Table 18:

- Most teachers rated the Preparation section as v*ery helpful* across all lessons.
- The Preparation section for Lesson 1 was rated the highest with one teacher rating it as *very helpful* and two rating it as *extremely helpful*.

  Preparation: very specific. [Lesson 1]

  The preparation description was very clear, though my room is quite messy so I had to set up stations with the note and a plate of the cut up materials. [Lesson 1]

- The helpfulness of the Preparation section was rated the lowest for Lesson 7, with all three teachers rating it as *somewhat helpful*.

Table 18
Helpfulness of Preparation

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	0	1	2	0
2	0	0	0	1	1	3
3	0	0	0	2	1	0
4	0	0	0	2	0	0
5	0	0	0	3	0	0
6	0	0	0	3	0	0
7	0	0	3	0	0	0
8	0	0	0	3	0	0
9	0	0	1	1	1	0
11	0	0	0	2	0	0

Assessment

The helpfulness of the assessment section for each lesson was rated by teachers, as shown in Table 19:

- Most teachers rated the Assessment section as *somewhat* or v*ery helpful* across all lessons.

Table 19
Helpfulness of Assessment

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	1	1	0	1
2*	-	-	-	-	-	-
3	0	0	1	2	0	0
4	0	0	1	1	0	0
5	0	0	0	3	0	0
6*	-	-	-	-	-	-
7*	-	-	-	-	-	-
8*	-	-	-	-	-	-
9*	-	-	-	-	-	-
11	0	0	1	1	0	0

* The Assessment section was not yet developed for these lessons so there are no ratings.

Instructions/Lesson Plan

Teacher ratings of instructions/lesson plans are displayed in Table 20:

- Most teachers rated the Instructions/Lesson Plan as v*ery helpful* across all lessons.
- The Instructions/Lesson Plan was rated the highest for Lessons 1 and 3 with one teacher rating it as *extremely helpful* and the others rating it as *very helpful*.

  The directions were clear and concise. [Lesson 3]

  The lesson plan was great. [Lesson 3]

- The Instructions/Lesson Plan for Lesson 2 was rated as *somewhat helpful* by three of the five teachers.

Table 20
Helpfulness of Instructions/Lesson Plan

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	0	2	1	0
2	0	0	3	1	1	0
3	0	0	0	2	1	0
4	0	0	0	2	0	0
5	0	0	0	3	0	0
6	0	0	0	3	0	0
7	0	0	1	2	0	0
8	0	0	0	3	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Handouts

Teachers rated the helpfulness of the handouts, as shown in Table 21:

- Most teachers rated the handouts as v*ery or extremely helpful* across all lessons.

  Handouts provided detail and supported students [Lesson 3]

  The handouts were extremely helpful to the students in achieving all of their goals. The majority of the students really benefited from the following handouts: 1, 7, 8, & 10-15. They were able to identify with what they were studying much easier using the handouts, The handouts also made the lesson more interesting. [Lesson 7]

  Instructions clean and handouts well organized, easy for students to read or complete. [Lesson 9]

- The handouts were rated the lowest for Lessons 2 and 6, with three teachers rating them as *a little helpful* for Lesson 2 and two teachers rating them as *a little helpful* for Lesson 6.

  The handouts were great, yet they seemed somewhat vague to some of the students, such as the "Plants and People" handout, and then the "Concept Mapping" handout was great overall, but was somewhat overwhelming for a handful of the students. For those students, I had to review it with them periodically. [Lesson 2]

  The concept map sample would have been more helpful if another example about something the students are familiar with was also provided. [Lesson 2]

  Pictures a bit small. [Lesson 6]

  The piece on the bar coding/DNA barcoding was a little misplaced. It really wasn't a learning goal; more of a side bar rather than an easily related info. Maybe best left to another lesson, rather than this one on commercially valuable crops. [Lesson 6]

Table 21
Helpfulness of Handouts

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	1	0	1	1	0
2	0	3	1	0	1	0
3	0	0	0	2	1	0
4	0	0	1	1	0	0
5	0	0	0	2	0	0
6	0	2	0	1	0	0
7	0	0	1	1	1	0
8	0	0	0	3	0	0
9	0	0	1	1	1	0
11	0	0	0	2	0	0

References

Reference list ratings for each lesson are displayed in Table 22:

- Most teachers rated the Reference List as *somewhat* to v*ery helpful* across all lessons.

Table 22
Helpfulness of References

Lesson	Not at all helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful	N/A
1	0	0	1	1	0	1
2*	-	-	-	-	-	-
3	1	0	1	1	0	0
4	0	0	1	1	0	0
5*	-	-	-	-	-	-
6	0	1	0	2	0	0
7*	-	-	-	-	-	-
8*	-	-	-	-	-	-
9*	-	-	-	-	-	-
11	0	0	0	2	0	0

* These lessons did not include a reference list.

Comments and Suggestions for Lesson Components

Teachers were asked to provide examples for components they rated as *very* or *extremely* helpful and suggestions for improvement for components they rated as *not at all* or *a little* helpful. Because most teachers rated most components as *somewhat* to *extremely* helpful, more examples than suggestions were provided. However, many teachers provided suggestions even when they rated a component highly. Summaries of teacher's comments and suggestions for each lesson are presented below in Table 23.

Table 23
Positive Comments and Suggestions for Improvement for Helpfulness of Lesson Components

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Preparation description was very clear. ▪ List of materials very specific. ▪ Handouts provided good information for students.	▪ Did not understand evidence cutout from handout.
2	▪ Simple and to the point ▪ Lesson plan well detailed ▪ Students paid attention and achieved the learning goals	▪ Provide better examples or a sample concept map of something students are familiar with.
3	▪ All aspects well presented and organized. ▪ Directions clear and concise. ▪ Handouts are detailed and support students	▪ Could not find information for homework reading
4	▪ All parts presented well. ▪ Similar to other botany lessons. ▪ Good objectives and lesson plan.	
5	▪ Preparation easy. ▪ Instructions easy to understand. ▪ Layout of lesson easy to follow.	▪ Include more Internet references that teacher can use to read more about topic. Books are too hard to find. ▪ Interviews did not contain enough information for students.
6	▪ Preparation well defined. ▪ Easy to obtain products. ▪ Format easy to follow.	▪ Pictures on handouts were a bit small. ▪ Piece on DNA barcoding did not seem to fit with lesson.
7	▪ Handouts had good information. They were extremely helpful to the students as they achieved their goals. ▪ Learning goals were especially helpful. They provided specific links for students and were well linked together. ▪ Instructions and lesson plan very thorough.	▪ Would like to see video. ▪ Cutting out cards was time consuming.
8	▪ The map was nice. ▪ Easy to implement. ▪ Students learned a lot when they worked in teams to answer questions posed by the teacher.	
9	▪ The lesson overview was easy to understand and it was helpful to know the order of the lesson. ▪ The lesson plan and goals were well organized and easy to implement. ▪ Handouts were easy for students to read.	
11	▪ Lesson plan was clear. ▪ Materials were easy to obtain ▪ References were helpful. ▪ Students enjoyed using the handouts.	

Ratings of Lesson Aspects

Teachers were asked to rate several aspects of each lesson they used, using a 5-point scale from *Poor* to *Excellent*. A summary of results is presented first, followed by the same information, in more detail, with representative quotes and tables. Finally, a summary of open-ended responses is presented.

Summary of Ratings of Lesson Aspects

Overall, most teachers rated aspects of each lesson as *good* to *very good* (ratings of 3 or 4 out of a possible 5). Of all lessons, Lesson 7 received the highest ratings for opportunities for student group work and student inquiry learning, while Lesson 3 was rated the highest for ease of preparation and accurate time estimates. Lesson 9 also received high ratings for time estimates and transition from one activity to the next. While Lesson 2 was rated the highest for ease of preparation and opportunities for student group work, it was rated the lowest for time estimates, and teachers had varying opinions about the opportunities for student learning.

While no lessons received rating lower than a 2 on the 5-point scale, Lesson 6 was rated the lowest for visual appearance. In their open-ended comments, teachers indicated that they had difficulty seeing the picture of the orchids, which likely contributed to their low visual appearance ratings.

Teachers suggested improving the handouts for Lessons 1, 3, and 5, and suggested including more examples or background information for Lessons 2, 4, and 5. They indicated that Lessons 2 and 7 took longer than stated to complete.

Ease of Preparation

Teachers rated the ease of preparation, as shown in Table 24:

- Most teachers rated the ease of preparation as *good* or *very good* across lessons.
- Lessons 2 and 3 were rated the highest with all teachers rating the ease of preparation as *very good* or *excellent*.

  Easy to prepare as there were no out of class materials needed. [Lesson 2]

  The ease of preparation in this lesson was very simple for the students, and myself. [Lesson 2]

  It took very little time to set up the flowers. [Lesson 3]

  Much easier to prepare than lesson 1 [Lesson 3]

Table 24
Ease of Preparation

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	2	0	1
2	0	0	0	3	2
3	0	0	0	2	1
4	0	0	1	1	0
5	0	0	1	2	0
6	0	0	1	2	0
7	1	0	2	0	0
8	0	0	1	2	0
9	0	0	0	3	0
11	0	0	0	2	0

Time estimate provided

Teachers rated the time estimates provided for each lesson, shown in Table 25:

- Most teachers rated the time estimates provided as *good* or *very good* across lessons.
- Lessons 2, 5, and 7 were rated the lowest with one to two teachers each rating time estimates for these lessons as *poor* or *fair*.

  I needed two class periods; one class period (1 hour) to "build the concept map, and another for groups to present maps to class. [Lesson 2]

  I needed three days (50 minute class period) to really feel as if I was covering the material; 1 day to discuss co-evolution, and to begin intro of the project, 1 day to read witness accounts and to begin handout 2, and a 3rd day to finish it and the "newspaper article." [Lesson 5]

  The time estimates for this lesson were slightly unreasonable. The students, depending upon the group, needed more time than others, especially in session two. [Lesson 7]

- Time estimates were rated the highest for Lessons 3 and 9 with all teachers rating them as *very good* or *excellent.*

  The time estimates were very accurate, and precise. [Lesson 9]

Table 25
Time Estimates Provided

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	1	2	0
2	1	0	2	1	1
3	0	0	0	2	1
4	0	0	1	1	0
5	0	1	1	1	0
6	0	0	1	2	0
7	0	2	1	0	0
8	0	0	1	2	0
9	0	0	0	2	1
11	0	0	0	2	0

Transition from one activity to the next

As shown in Table 26, teachers rated transitions between activities:

- Most teachers rated the transition from one activity to the next as *good* to *very good* across all lessons.

  There was a flow from part 1 through the end, though I did find the directions need a little revision. We asked students about what type of crimes but I think we need to clarify the crime itself and what they are looking for. I think in the final copy the images will be larger, I hope. It did allow me to start with what students knew about plant parts and they were able to run the investigation which encouraged more questions. [Lesson 1]

  Pretty easy to move students from one activity to the next. [Lesson 7]

- The transition between activities was rated the highest for Lesson 9, the only lesson to receive an *excellent* rating from a teacher.

  The students were able to transition from one activity within the lesson to another very smoothly, without any reservations. [Lesson 9]

Table 26
Transition from one activity to the next

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	0	3	0
2	0	0	2	3	0
3	0	0	2	1	0
4	0	0	1	1	0
5	0	0	1	2	0
6	0	0	1	2	0
7	0	0	2	1	0
8	0	0	1	2	0
9	0	0	0	2	1
11	0	0	0	2	0

Visual appearance: Design and format

Design and format of the lessons were rated by teachers. As seen in Table 27:

- Teachers' ratings of each lessons' visual appearance ranged from *fair* to *excellent* across lessons.
- Lesson 6 was rated the lowest as two teachers rated its visual appearance as *fair* and one rated it as *good*.

  Pictures of orchids too small to compare differences. [Lesson 6]

  Color over heads of the three different vanilla orchids would be nice. The black and white photocopy made it harder to see the orchid's beauty and differences. [Lesson 6]

Table 27
Visual Appearance: Design and Format

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	1	2	0
2	0	1	1	2	1
3	0	0	1	2	0
4	0	0	1	1	0
5	0	1	0	2	0
6	0	2	1	0	0
7	0	1	1	1	0
8	0	0	1	2	0
9	0	0	1	2	0
11	0	0	0	2	0

Opportunities for student inquiry learning

Teachers' ratings of student inquiry learning opportunities are shown in Table 28:

- Most teachers rated the opportunities for student inquiry learning in each lesson as *good* or *very good*.
- One teacher rated Lesson 7 lower than the other two teachers who used this lesson. The teacher who rated Lesson 7 as *fair* teaches "at risk" students and commented that her students found this lesson too complicated and therefore they were probably not able to fully participate in the inquiry learning activities.
- Teachers had differing opinions about Lesson 2, with two teachers rating the opportunities for student inquiry learning as *poor* or *fair* and three teachers rating the opportunities as *very good* or *excellent*.

  My perception of student inquiry learning is for students to face question they don't know the answer to that gives them reason to search for answers or more understanding. Although this is a great activity to point out what economic connections there are between people and plants, it does so in a way that builds upon what students already know. [Lesson 2]

Table 28
Opportunities for student inquiry learning

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	2	1	0
2	1	1	0	2	1
3	0	0	1	2	0
4	0	0	1	1	0
5	0	0	1	2	0
6	0	0	2	1	0
7	0	1	0	1	1
8	0	0	1	2	0
9	0	0	1	2	0
11	0	0	0	2	0

Opportunities for student group work

Table 29 displays teachers' ratings of student group work opportunities:

- Most teachers rated the opportunities for student group work in each lesson as *very good*.
- Lessons 2, 3, and 7 were rated the highest with one teacher each rating the opportunities for student group work as *excellent* for these lessons.

They especially enjoyed using the post-it notes to bring it all together as a unit. The lesson gave my students a wonderful opportunity to expand upon their learning abilities; some touched on areas that they never had before. The lesson also gave a wonderful opportunity for the students to work together as teams, and they truly loved it! [Lesson 2]

Students worked together well from gathering flowers to dissecting them. [Lesson 3]

The student group work was very valuable in teaching the students how to work together to achieve goals. [Lesson 7]

Students worked together well especially counting and recording. [Lesson 7]

Table 29
Opportunities for student group work

Lesson	Poor	Fair	Good	Very Good	Excellent
1	0	0	1	2	0
2	0	0	0	4	1
3	0	0	0	2	1
4	0	0	1	1	0
5	0	0	0	3	0
6	0	0	1	2	0
7	0	0	1	1	1
8	0	0	1	2	0
9	0	0	1	2	0
11	0	0	0	2	0

Comments and Suggestions for aspects of each lesson

Teachers were asked to provide examples for aspects they rated as v*ery good* or e*xcellent* and suggestions for improvement for components they rated as p*oor* or f*air*. Because most teachers rated most components as g*ood* to e*xcellent*, more examples of positive comments than suggestions for improvement were provided. However, many teachers provided suggestions even when they rated a component highly. Summaries of teachers' comments and suggestions are presented below in Table 30.

Table 30
Positive Comments and Suggestions for Improvement for Lesson Aspects

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Lesson plan detailed. ▪ Good flow from Part 1 to the end. ▪ A good opening lesson for the unit.	▪ Handout 4 was not readable. Students could not understand it.
2	▪ Easy to prepare because there were no outside materials needed. ▪ Concept map was an attractive layout. ▪ Students enjoyed using post-it notes. ▪ A simple way to teach organization of information.	▪ Students had a hard time understanding concept map. Perhaps better activity for later in unit when students have more knowledge of botany. ▪ Took longer than expected. One class period for making map and one to present.
3	▪ Students worked well together. ▪ Easy to prepare. Set-up time was minimal.	▪ Combine Handouts 1 and 2.
4	▪ Preparation was easy. ▪ Good opportunities for teacher-student interaction.	▪ Include more examples of other types of fruit.
5	▪ Easy to implement. ▪ Many opportunities for students to participate. ▪ Students loved working together	▪ More pictures – hives, trees, forest at flood stage, fish, stingless bee ▪ Include more background on co-evolution.
6	▪ Preparation fairly easy.	▪ Difficult to pour extracts into cups. ▪ Make pictures of orchids larger or provide overhead. They were too small to compare.
7	▪ Students worked well together and moved easily from one activity to the next. ▪ Excellent opportunities for student inquiry learning and group work.	▪ Times estimates for lesson were inaccurate. It took longer than stated.
8	▪ Lesson plans well described. ▪ Easy to prepare. ▪ Students worked well in groups. ▪ Good for classes of different sizes because you could change size of groups.	
9	▪ Easy to prepare. ▪ Students worked well together and participated by contributing parts of their lunch. ▪ Students completely involved. ▪ Tasks well defined.	
11	▪ Students worked well together.	

IMPACT ON STUDENTS

Teachers were asked to assess their assigned lessons' impact on their students by rating students' reactions and information in student handouts, using a 5-point scale from *Not at all* to *Extremely*. If teachers could not rate an item, they could select N/A (*Not applicable*). A summary of results is presented first, followed by the same information, in more detail, with representative quotes and tables. Finally, a summary of open-ended responses is presented.

Summary of Impact on Students

Overall, teachers felt students were *very* interested in each lesson, that the student handouts and assessment activities were *somewhat* to *very* clear (3 or 4 out of 5 on the rating scale), and that each lesson was *somewhat* to *very* successful (3 or 4 out of 5 on the rating scale) at motivating students to want to learn more about topics covered in the lesson and about scientific research.

Compared to the other lessons, Lesson 9 received the highest ratings for student interest, clarity of information in student handouts, and success at motivating students to want to learn more about topics covered in the lesson and about scientific research. Lesson 1 also received high ratings for its success at motivating students to want to learn more about the topic covered.

Lesson 2 received the lowest ratings, compared to other lessons, for clarity of information in student handouts and motivating students to want to learn more about the topics covered in the lesson and about scientific research. The ratings are most likely due in part to the fact that Lesson 2 is an introductory lesson about concept mapping and does not teach students information about botany or encourage them to conduct scientific research.

Student Interest

Teachers rated their students' interest in each of the lessons they used. As shown in Table 31:

- Most teachers felt students were *very* interested in each lesson.
- Student interest was rated the highest for Lesson 9, with all three teachers indicating students were *extremely* interested in this lesson.

  My students were very interested in this lesson because they loved doing the experiment. [Lesson 9]

  Using students' own food made this more successful and effective. Better than teacher supplied food. [Lesson 9]

Table 31
Student Interest in Lesson

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	0	3	0	0
2	0	1	0	3	1	0
3	0	0	0	1	2	0
4	0	0	0	1	1	0
5	0	0	2	1	0	0
6	0	0	0	3	0	0
7	0	1	1	1	0	0
8	0	0	1	2	0	0
9	0	0	0	0	3	0
11	0	0	0	2	0	0

Information in Student Handouts

Teachers were asked to rate the clarity of information in the student handouts and student assessments.

Student Handouts

As shown in Table 32:

- Most teachers rated information in the student handouts as *somewhat* to *very* clear.
- The information in the handouts of Lesson 9 were rated the highest with two teachers rating the information as *very* clear and one teacher rating it as *extremely* clear.

  The student handout was very clear and simple, making it extremely easy for the students to understand and utilize it. [Lesson 9]

- The Lesson 2 handouts were the least clear; four of the five teachers rated the student handouts as *somewhat* clear.

Table 32
Clarity of information in Student Handouts

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	1	2	0	0
2	0	0	4	0	1	0
3	0	0	1	2	0	0
4	0	0	1	1	0	0
5	0	0	2	1	0	0
6	0	0	1	2	0	0
7	0	0	1	2	0	0
8	0	0	1	2	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Student Assessments

Teachers rated information clarity in student assessments, as shown in Table 33:

- Five of the lesson drafts contained Student Assessments for teachers to use.
- Most teachers rated the Student Assessments as *very* clear.

Table 33
Clarity of information in Student Assessments

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	1	1	0	1
2*	-	-	-	-	-	-
3	0	0	0	2	1	0
4	0	0	0	2	0	0
5	0	0	2	1	0	0
6*	-	-	-	-	-	-
7*	-	-	-	-	-	-
8*	-	-	-	-	-	-
9*	-	-	-	-	-	-
11	0	0	0	2	0	0

* These lessons drafts did not include Student Assessments

Effectiveness at increasing student knowledge

Teachers rated how effective they thought each lesson was at increasing students' knowledge of Economic Botany. As shown in Table 34:

- Most teachers felt each lesson was *somewhat* to *very* effective at increasing their students' knowledge of Economic Botany.

  Students understood the economic issues when I shared the prices of the various extracts we were using. They quickly noticed the difference between real vanilla and imitation. [Lesson 6]

  Students began looking at other items they use and determining what plants are used in production. Awareness raised! [Lesson 11]

- Teachers were unsure about the effectiveness of Lesson 2, with ratings ranging from *a little* to *extremely* effective. In the comments below, both teachers used the lesson with 6th grade students, so the age of students is most likely not a factor in students' ability to do the concept map activity.

  Students were frustrated with mapping activity, so the plant/people interaction was lost. [Lesson 2]

  The format was different. They loved playing with the post it notes, and being creative with building maps. There was really no right or wrong, and all learners could contribute successfully. It was a real "ah ha" moment for students when they saw the economic importance of the connections between plants and people. [Lesson 2]

Table 34
Effectiveness at increasing student knowledge of Economic Botany

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	1	2	0	0
2	0	1	1	2	1	0
3	0	0	1	2	0	0
4	0	0	0	2	0	0
5	0	0	1	2	0	0
6	0	0	1	2	0	0
7	0	0	2	1	0	0
8	0	0	1	2	0	0
9	0	0	1	1	1	0
11	0	0	0	2	0	0

Success at motivating students to learn more about topic covered

Teachers rated how successful they thought each lesson was at motivating students to want to learn more about the topic they studied. As shown in Table 35:

- Most teachers felt each lesson was *somewhat* to *very* effective at motivating students to learn more about the topic.

- Lesson 2 received the lowest ratings, with four of five teachers indicating it was *a little* or *somewhat* successful at motivating students to learn more about the topic covered (concept mapping).
- Lessons 1 and 9 received the highest ratings as two teachers rated them as *very* successful and one teacher rated them as *extremely* successful.

From investigating samples, students were ready to look in their yards for other specimens to evaluate. [Lesson 1]

This was a very good lesson to motivate students- it helped to give background for lesson 2. [Lesson 1]

This lesson was very successful in motivating the students to delve more into its topic. Again, the main reason, being that they loved conducting the experiment, finding the topic even more interesting. [Lesson 9]

Table 35
Success at motivating students to learn more about topic

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	0	2	1	0
2	0	1	3	0	1	0
3	0	0	0	3	0	0
4	0	0	0	1	1	0
5	0	0	2	1	0	0
6	0	0	1	2	0	0
7	0	1	1	1	0	0
8	0	0	1	2	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Success at motivating students to learn more about scientific research

Teachers rated how successful they thought each lesson was at motivating students to want to learn more about scientific research. As shown in Table 36:

- Most teachers felt each lesson was *somewhat* to *very* effective at motivating students to learn more about scientific research.
- Lesson 2 received the lowest ratings, with four of five teachers indicating it was *not at all* to *somewhat* successful at motivating students to learn more about scientific research. However, Lesson 2 was meant to introduce the curriculum by teaching concept mapping, not research skills, which may account for teachers' ratings.

I see this specific lesson as a "pre-lesson" activity, not really a lesson that drives home the scientific research angle, and that is ok. [Lesson 2]

- Lesson 9 received the highest ratings, as two teachers rated it as *very* successful and one teacher rated it as *extremely* successful at motivating students to learn more about scientific research.

  Due to the experiment really catching their attention, the students expressed a true motivation for wanting to learn more in the area of scientific research. [Lesson 9]

Table 36
Success at motivating students to learn more about scientific research

Lesson	Not at all	A little	Somewhat	Very	Extremely	N/A
1	0	0	2	1	0	0
2	1	1	2	0	1	0
3	0	0	2	1	0	0
4	0	0	0	2	0	0
5	0	0	2	1	0	0
6	0	0	1	2	0	0
7	0	1	0	2	0	0
8	0	0	1	2	0	0
9	0	0	0	2	1	0
11	0	0	0	2	0	0

Comments and Suggestions for lessons' impact on students

Teachers were asked to provide examples for statements they rated as v*ery* or e*xtremely* and suggestions for improvement for statements they rated as n*ot at all* or a *little*. Because most teachers did not give statements ratings lower than s*omewhat* (3 out of 5), more positive comments than suggestions for improvement were provided. Summaries of teachers' comments and suggestions for each lesson are presented below in Table 37.

Table 37
Positive Comments and Suggestions for Improvement for Impact on Students

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Students motivated to evaluate specimens from their own yards. ▪ Students will be doing research project about illegal exports. ▪ Students used information from handouts in their presentations. ▪ This lesson helped give background for Lesson 2.	▪ Include motive.
2	▪ Students loved playing with post-it notes. ▪ Students learned a lot and all could contribute because there was no right or wrong answer. ▪ Students loved activity and were motivated by topic of plants and people.	▪ Students were frustrated with mapping activity.
3	▪ Students were interested in dissecting flowers. ▪ Appropriate for the spring, when flowers are blooming. ▪ Students asked questions about flowers after doing activity.	
4	▪ Students requested to dissect other fruits. ▪ Student enjoyed looking in lunch bag for fruits with seeds.	
5	▪ Student handouts gave specific questions and helped them form solutions.	
6	▪ Students understood economic issues when teacher shared prices of the extracts they were using. ▪ Students loved smelling extracts and guessing where they were from. ▪ Easy to tie in stingless bee from previous lesson.	▪ Some students tried to include stingless bee from previous lesson in this lesson. They did not understand that it was not included.
7	▪ Students understood format of activities because the previous lesson was similar. ▪ Information in student handouts clear. ▪ Provided students with opportunity to do hands-on scientific research.	▪ Include general discussion of rattan furniture and other products at beginning of lesson to help students understand lesson. ▪ Lesson was too complicated for students.
8	▪ Lesson turned to discussion of the use of local seeds in crops. ▪ Enjoyed seeing students work in teams.	
9	▪ Using students own food made this very successful. ▪ Students very interested in experiment. ▪ Student handout clear and simple, making it easy for students to use. ▪ Positive student reaction to lesson.	
11	▪ Students looked at other items they use and tried to determine what plants were used to make them. ▪ Raised awareness of how plants are used.	

Appropriateness of Content for Students

Teachers were asked to indicate if the content of each lesson was *too difficult*, *too easy*, or *just right* for their students.

As shown in Table 38, their ratings of appropriateness of content indicate that:

- Most teachers felt the content of each lesson was *just right* for their students.
- One teacher felt the content of Lesson 2 was *too difficult* for her students.
- One teacher indicated Lessons 5, 7, and 8 were too difficult for her students, though this teacher teaches "at risk" students, which may explain her ratings.

Table 38
Appropriateness of content for students

Lesson	Too difficult	Too easy	Just right
1	0	0	3
2	1	0	4
3	0	0	3
4	0	0	2
5	1	0	2
6	0	0	3
7	1	0	2
8	1	0	2
9	0	0	3
11	0	0	2

OVERALL OPINIONS OF THE LESSONS

Teachers were asked to rate their overall opinions of each lesson they used by rating, using a 5-point scale from *Not at all* to *Extremely*, how easy it was to implement each lesson in their classroom and how satisfied they were with their implementation of each lesson.

Ease of implementing each lesson

Teachers rated how easy it was to implement each lesson, displayed in Table 39:

- Most teachers indicated each lesson was *very* easy to implement in their classroom.
- Lesson 3 was the easiest to implement with all three teachers rating it as *extremely* easy.

  Especially easy because spring flowers are blooming. If done in the winter I would have had to purchase flowers from florist. Still doable, but not as interesting. [Lesson 3]

Nice lesson- learned a lot- but easy to complete [Lesson 3]

Table 39
Ease of implementation

Lesson	Not at all	A little	Somewhat	Very	Extremely
1	0	0	2	1	0
2	1	0	0	3	1
3	0	0	0	0	3
4	0	0	0	2	0
5	0	0	1	2	0
6	0	0	1	2	0
7	0	1	0	2	0
8	0	0	0	2	1
9	0	0	0	2	1
11	0	0	1	1	0

Teachers were asked to explain their ratings by providing specific examples or specific suggestions for improvement. A summary of teachers' responses is presented below in Table 40. Teachers indicated the lessons were easy to implement because materials were easy to obtain, directions were clear, and students were excited to use the lesson.

Table 40
Positive Comments and Suggestions for Improvement for Ease of Implementation

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Able to use plants from school yard. ▪ There are a lot of orchid dealers in Florida, so they were easy to find.	▪ Need posters for alternate items that are easier to find, such as violets or carnations.
2	▪ Simple, easy lesson to implement. ▪ Great way to introduce connection between plants and people.	▪ Students were frustrated with mapping activity.
3	▪ Easy to implement because Spring flowers were blooming. ▪ Clear, concise directions.	▪ Would like to see connection between structure of pollination and problem of plants not pollinating.
4	▪ Fruits easy to obtain. ▪ Students able to identify structures of most fruits.	
5	▪ Easy to implement because no outside materials needed. ▪ Easy to tie into school curriculum of ecology.	
6	▪ Easy to set up after obtaining items from store. ▪ Good for kids to see economic impact of a loss of a pollinator. ▪ No problems except finding vanilla beans.	
7	▪ Easy to implement because lesson plans included both inside and outside plans. ▪ Easy to implement because students love researching new things.	
8	▪ Easy to use. ▪ Comfortable using lesson.	
9	▪ Basic lab experiment – easy to do with materials on hand. ▪ Easy to implement because students were motivated from last lesson. ▪ Comfortable using with students.	
11	▪ Easy to use. ▪ Materials organized.	

Satisfaction with implementation

Teachers rated their satisfaction with implementation. As shown in Table 41:

- Most teachers indicated they were *very* to *extremely* satisfied with their implementation of each lesson they used.

  This was the best inquiry lesson I have used this year. [Lesson 1]

  I was very satisfied with the implementation of the lesson, as it really took me by surprise how the students eagerly got involved, and wanted to be a part of it. [Lesson 2]

  I am extremely satisfied with the whole outcome of implementing the lesson in my classroom. The students were very eager from beginning to

end; each session was both fun and educational for the students. [Lesson 7]

I was extremely satisfied with my implementation of the lesson in my classroom, as the student's motivation and involvement made it even more worth it. It was a truly enjoyable experience, for myself and the students! [Lesson 9]

- Only two teachers were less than *very* satisfied with their implementation of some of their assigned lessons. One teacher was *not at all* satisfied with Lesson 2 and *somewhat satisfied* with Lesson 11, while the second teacher was *a little* to *somewhat satisfied* with her implementation of Lessons 5, 6, 7, and 8. The second teacher teaches "at risk" students, which may have made it more difficult for her to implement the lessons.

Table 41
Satisfaction with implementation

Lesson	Not at all	A little	Somewhat	Very	Extremely
1	0	0	0	3	0
2	1	0	0	2	2
3	0	0	0	2	1
4	0	0	0	1	1
5	0	0	1	2	0
6	0	0	1	2	0
7	0	1	0	2	0
8	0	1	0	2	0
9	0	0	0	2	1
11	0	0	1	1	0

Teachers were asked to explain their ratings by providing specific examples or specific suggestions for improvement. A summary of teachers' responses is presented below in Table 42. Most teachers indicated they were satisfied with their implementation of each lesson because students were engaged and learned from the activity. Some teachers also indicated they were satisfied because materials were easy to obtain and activities were easy to prepare for and implement.

Table 42
Positive Comments and Suggestions for Improvement for Satisfaction with Implementation

Lesson	Positive Comments	Suggestions for Improvement
1	▪ Easy to prepare and implement. ▪ Something unique for students to do. ▪ Best inquiry lesson used so far this year.	
2	▪ Great way to pre- and post- assess student about a topic. ▪ Students were engaged in activity.	▪ Students were frustrated with mapping activity.
3	▪ Piqued students' curiosity. ▪ Students understood function of flower structures.	
4	▪ Fruits easy to obtain and something students are familiar with.	
5	▪ Students worked well together. ▪ Liked interdisciplinary team approach and writing opportunity.	
6	▪ Great brainstorming activity because students were challenged. ▪ Students liked smelling activity because it was different from what they usually do.	▪ Would like more hands-on opportunities for students to work with the vanilla.
7	▪ Students liked detective role. ▪ Students engaged from beginning to end of activity.	▪ Allow more time for session 2. ▪ Was not able to have students work independently.
8	▪ Students worked well in groups. ▪ Easy to prepare.	
9	▪ Students liked checking own foods. ▪ Students motivated and involved. ▪ Impressed with examples and test.	
11	▪ Students liked activity and participating in groups.	

SUGGESTIONS FOR IMPROVEMENT

Teachers were asked to write any additional suggestions they had for improving each lesson they used. Teachers' suggestions are presented below in Table 43. Common suggestions included improving student handouts, providing more background information or examples for students and teachers, providing teachers with overhead transparencies, and correcting typos.

Table 43
Suggestions for Improvement

Lesson	Suggestions for Improvement
1	▪ Improve handout #4 ▪ A blank template to use for substituted items ▪ More direction as to what students should look for. They struggled with differentiating the roots of the cactus versus the roots of the orchid.
2	▪ More references. ▪ Possibly being a little more explanatory in the handouts for the students, especially the "Concept mapping" handout. Such as giving more examples for the students. ▪ Resources for the homework assignment ▪ More web links or better pre teaching info on concept mapping. A blank template to use for substituted items.
3	▪ More flower examples of different types of flowers. ▪ More background on self pollination flowers so that I could help students with their questions.
4	▪ The diagrams of the pericarp were a bit confusing.
5	▪ Errors in handout 5: Hive keeper: My family have been honey collectors... Should read: My family has been honey collectors... Hive keeper: You may have seen an article in the newspaper recently about that?... Remove "?" as this is not a question. Later same paragraph... large old trees which it a problem... Corrected...large old trees which is a problem... Handout 6: Community Leader, second quote, end of quote remove the word Some from the end of quote, or add rest of the sentence. ▪ More background on Co-evolution (at least more specific examples). Students don't really know more than bees/flowers. ▪ Color transparency of a stingless bee
6	▪ Color overheads of the different orchids
7	▪ Lesson plan session 1, 3. Teams have a 5'x5' area. Student handout 6, 1. Students to mark off 2mx2m section. Please use consistent measurements, meters or feet/inches.
8	▪ Typo/ grammar errors: Handout 1 , line 4 Thousands of people <in the> in many regions... remove <words> handout 5, last answer, line 2, We also <swop> rice seeds...<trade, exchange, etc> poor word choice/ spelling error Handout 6, last answer line 1, ...the rice<panicles> carefully... should be <particles?> Handout 7, 1st answer, 2nd line, ...the point at <where> we could... should be <which>
9	▪ Caution that using iodine that it will stain skin, surfaces, and clothing.
11	(no additional suggestions provided)

OVERALL CURRICULUM FEEDBACK

After using all their assigned lessons, teachers completed questions about their impressions of the Economic Botany curriculum overall. Responses from these questions are presented below.

Ratings of Curriculum Aspects

Teachers were asked to rate several aspects of the curriculum overall, using a 5-point scale from *Not at all* to *Extremely*. As shown in Table 44:

- Clarity of instructions/handouts and ease of implementing the curriculum in their classroom were rated high. All six teachers rated the Instructions/Lesson plans as *very* clear and indicated it was *very* easy to use the lessons in their classroom.

- Overall, student interest was rated high; with five teachers indicating students were *very* interested in the lessons overall and one teacher indicating students were *extremely* interested.

Table 44
Opinions of Overall Curriculum

	Not at all	A little	Somewhat	Very	Extremely
How easy was it to use the lessons from this curriculum in your classroom?	0	0	0	6	0
How easy was it to obtain the materials and equipment needed to conduct the lessons?	0	0	2	3	1
How clear were the instructions/lesson plans?	0	0	0	6	0
How accurate were the time estimates provided (duration of lesson)?	0	0	2	4	0
How interested were your students in the lessons overall?	0	0	0	5	1
How relevant was the content to your students' lives?	0	0	2	4	0
How effective were the lessons at increasing your students' knowledge of Economic Botany?	0	0	1	4	1
How well did Economic Botany align with district and state standards in your specific subject area?	0	0	2	4	0
Overall, how satisfied were you with the Economic Botany lesson you used?	0	0	1	4	1

Lessons Learned by Students

Teachers were asked, in an open-ended format, to describe the most important lesson students learned from the Economic Botany curriculum.

Three teachers commented that students learned something about how plants impact the economy and our daily lives.

> *How tied the world's economy really is to all growing things.*
>
> *The students learned that without plant life, we as a whole in society could not exist. They learned the important value of plant life, and how it affects our day-to-day living, producing, and functioning in society.*
>
> *The importance of plants to their everyday lives.*

The remaining three teachers wrote that their students learned something about plants or crops.

> *I think the illegal plants were the most interesting to them but overall I think they learned quite a bit about structure and function of plant parts.*
>
> *Differences in nature.*
>
> *Small changes can dramatically affect plant/ crop yield*

Overall Success of Implementation

Teachers were asked to rate, using a 5-point scale from 1 (*Not at all successful*) to 5 (*Completely successful*), how successful their overall implementation of Economic Botany was with their students. All six teachers indicated their implementation was *very successful* (a rating of 4 out of 5).

Future Use of Economic Botany

Plans to use Economic Botany in the future

Teachers were asked on each individual lesson feedback forms, how likely they were to use each lesson again next year. As displayed in Table 45:

- Most teachers indicated they were *very* to *extremely* likely to use each lesson again next year.
- The teacher who indicated she was *not at all* to *a little* likely to use Lessons 5, 6, 7, and 8 again next year, teaches "at risk" students who had difficulty completing the activities.

Table 45
Likely to use lessons again next year

Lesson	Not at all likely	A little likely	Somewhat likely	Very likely	Extremely likely
1	0	0	1	2	0
2	0	1	0	2	2
3	0	0	0	2	1
4	0	0	0	1	1
5	0	1	0	2	0
6	0	1	0	2	0
7	1	0	0	2	0
8	0	1	0	2	0
9	0	0	0	2	1
11	0	0	1	1	0

On the final survey, teachers were asked whether they plan to use other Economic Botany lessons with students once they receive the full curriculum. All six teachers indicated that they did plan to use the curriculum in the future. Comments included:

> *Nice tie to my existing curriculum. Students can see similar impacts that we talk about in regional issues in other areas of the globe.*

> *I plan to use Economic Botany lessons in the future, as the students were truly educated by the lessons, and enjoyed learning Economic Botany.*

I liked the approach that, along with content, could provide problem based learning

It was a well put together set of lessons- just needed more additional materials.

Teachers were also asked if they had taught or planned to teach students additional information about botany or if the Economic Botany lessons were the only information about botany that they would cover with their students. Four teachers planned to teach their students additional information about botany now that they had completed the Economic Botany lessons. Two teachers had previously taught about botany and also planned to teach additional information now that they had finished the Economic Botany lessons.

How best to use the lessons

Teachers were asked to indicate, by selecting one of four statements, whether the lessons should always be used in conjunction with one another or whether they could be used separately. Five teachers responded that "*some of the lessons could easily stand alone*," and one teacher indicated that "*each lesson could easily be used independently (i.e. could stand alone)*."

Final Comments

Teachers were asked to share, in an open-ended format, any additional comments they had about Economic Botany. Four teachers provided comments and complimented the curriculum or provided additional suggestions.

Students liked some activities more than others, but overall enjoyed the challenges presented. At the end of the course there could be a memo congratulating "agents" on completing assignments and inviting them back for more "cases".

The lessons were a wonderful experience and opportunity for me and my students, thank you for letting us be a part of the Economic Botany Curriculum.

Nice lessons- enjoyed testing them.

Please develop the Problem based learning opportunities a little more. Thanks for the opportunity to try these out.

COMPARISONS TO UNIT 1: ETHNOBOTANY

Overall, teachers who used Economic Botany felt more positive about the curriculum than did teachers who used Ethnobotany in the previous field test.

- Most teachers who used Economic Botany indicated the time estimates for each lesson were realistic. In contrast, all middle school teachers who used Ethnobotany mentioned that the suggested time frame was inadequate for students.

- All six teachers indicated that, overall, the Economic Botany instructions/lesson plans were *very* clear, while teachers who used Ethnobotany described the Teacher Guide as confusing and challenging.

- Teachers who used Economic Botany indicated the overall curriculum aligned with their district's standards *somewhat* to *very* well, while teachers who used Ethnobotany had difficulty using it because it did not align with their district's standards.

- Most teachers who used Economic Botany reported the curriculum was *somewhat* to *very* effective at motivating students to learn more about scientific research. In contrast, only two of seven teachers who used Ethnobotany reported the curriculum gave students as appreciation of scientific research.

- Most teachers who used Economic Botany indicated the content was just right for their students, while all seven teachers who used Ethnobotany indicated the curriculum level was too difficult for middle school students.

Teachers who used Economic Botany also provided some feedback that was similar to feedback from teachers who used Ethnobotany.

- Most teachers who used Economic Botany indicated their students were *very* or *extremely* interested in each lesson they used. Similarly, all teachers who used Ethnobotany indicated the curriculum was very engaging to students.

- Most teachers who used Economic Botany responded that each lesson they used was *somewhat* to *very* effective at increasing students' knowledge of Economic Botany. Similarly, six out of seven teachers who used Ethnobotany reported the curriculum increased students' knowledge of plants.

- Teachers in both studies requested more background information and references be added to the lessons.

ECONOMIC BOTANY VIDEO

During May and June 2006, GRG emailed all six teachers and asked if they would be able to review a rough cut of the video that will accompany the Economic Botany Curriculum. Five teachers agreed to review the video and they were instructed to watch the video on their own or with their students and to then email GRG a paragraph of feedback about the video.

Four teachers emailed their comments to GRG. Of those, two had used it with their students and two had viewed in on their own. Overall the teachers thought the video was very informative and would help their students better understand material in the Economic Botany curriculum. Both the teachers who previewed the video on their own and those who watched it with their students agreed that most of the video would hold students' interest, but that students may become bored with some of the scientist interviews. Teachers' comments are presented below.

- *Wish I had it to share with my students when we were testing out the lessons. Did not see a direct chapter on the video that coincided with my lesson BUT it was terrific and blends well. I loved the DNA aspect of the vanilla orchid, the rice research question, and the sampling techniques.*

- *Intro: Good, lots of examples of plant based products to catch students' interests, great explanations of products.*

  Vanilla segment: Scientist- good camera presence, explains ideas and processes well with enough detail to interest students but not too much to bore them. Explains ideas well. Easy to understand.

  Rice segment: Scientist's hair keeps falling in her face, very distracting! Planting and harvesting interesting, how fast they work.

  Mynar: Volume level much lower than previous segments, had to adjust volume on TV. Scientist pretty boring to watch/ listen to. Explanation of measuring plot interesting and will help students in their own measuring project.

  Overall comments: Voice quality of the narrator is distorted at beginning of each segment. Difficult to listen to. I think these video clips will work well with the written lessons to help students understand better what the projects are all about. Video footage is good, lots of detail.

- *The video contains very good information starting from basics how botany is used in daily life, how they are used in daily products and food and fiber, comparison of items depending on qualities and different types, and research conclusions and expert views on plants of different countries and specialties. Overall I like its simplicity, easy and very good editing. I enjoyed it. I viewed 4 times, 2 times with kids. They also*

enjoyed some basics, so it's easy for them to understand what we are doing.

- *Watched the Economic Botany DVD with my students on Friday. Although I tested the Vanilla Orchid curriculum, we were able to preview the entire DVD.*

  Both my 6th grade students and I found it rather lacking of energy. The students thought of the scientists as too "monotone". Although I think it is perfect to show the scientist at work in their labs, and to interview them, it might be more appropriate to have less of them on camera and their voice over what it is they are talking about.

  I felt the segment on genetic bar-coding too advanced (maybe just too long??) for most 6th grade students and perhaps for all middle school students. It might have been nice to have seen a shot or segment of hand pollination of the vanilla orchid to show how labor intensive it is.

  Students liked the segment on rattan; they liked seeing where it was on the map and the locals taking part in the sampling. They loved seeing the tiger. I don't think however, that managing the land for rattan exploitation and endangered species or even sustainability came across too well.

  The rice segment was the most informative and interesting. The scientist had better energy. The different varieties of rice were great. Everyone wanted to see a picture of the sticky rice dessert from Thailand. I picked up on the important concept that new technologies/varieties of growing rice need new management practices; more water, application of pesticides, herbicides etc that impact the watershed. I would have liked that to have been brought out more. A graphic of the world population that depends on rice as a major part of their diet would have been nice, too.

SUMMARY AND RECOMMENDATIONS

SUMMARY OF RESULTS

Overall, teachers provided very positive feedback about the individual Economic Botany lessons they used and about the curriculum overall. Teachers spent approximately 30 to 120 minutes preparing to use each lesson and, based on the lesson plan they received, most teachers felt *very prepared* to use each lesson. Most rated the ease of preparation for each lesson as *very* easy and only two teachers had difficulty obtaining materials for one of the lessons they used.

Components of each lesson were rated positively by teachers. Most teachers rated each section of the lesson plan as *very helpful*. The transition from one activity to the next within each lesson was rated as *good* to *very good* and most teachers

rated the opportunities for student inquiry learning and student group work as *very good*.

Teachers felt the curriculum had a positive impact on students. Teachers indicated that students were *very* interested in most lessons and that most lessons were *somewhat* to *very* effective at increasing students knowledge of Economic Botany and motivating students to learn about Economic Botany topics and scientific research. They also felt the content was appropriate for students – neither too difficult nor too easy.

Teachers indicated that each lesson was *very* easy to implement and they were *very* to *extremely satisfied* with their implementation of the curriculum. Most teachers were *very* to *extremely likely* to use their assigned lessons again next year and planned to use additional lessons with students once they received the entire curriculum.

SUMMARY OF COMMENTS FOR EACH LESSON

Below is a summary of positive and negative comments teachers provided for each lesson they used.

Lesson 1:
- Motivated students to investigate their own yards and discuss invasive plant species
- Preparation and Materials list clear and specific
- Lesson plan detailed
- Good flow from one activity to the next
- Students did not understand evidence cutouts
- Need more direction for teachers to connect ideas to plant parts

Lesson 2:
- Good hands-on approach.
- Good assessment tool.
- Lesson plan well detailed.
- All students could contribute.
- Students enjoyed using post-it notes.
- Students had trouble understanding concept mapping. Provide more examples for students.

Lesson 3:
- Easy to relate to real-life issues.
- Directions clear and concise.
- Student handouts detailed and supported students.
- Students worked well in groups.
- Students enjoyed dissecting flowers.
- No clear problem stated for students.
- Need more background information for teachers.

Lesson 4:
- Easy to prepare and implement.

- Good opportunities for teacher-student interaction.
- Students enjoyed looking for fruits in their lunches.
- Need more examples of other fruits.

Lesson 5:
- Easy to prepare and implement.
- Easy to relate to real-life issues and other plant species in community.
- Instructions easy to understand.
- Students loved working together.
- Student handouts gave specific questions to students.
- Include more Internet references and background for teachers.
- Include more pictures for students.

Lesson 6:
- Lesson plan clear and easy to follow.
- Preparation well defined and easy to obtain products.
- Easy to tie to everyday life.
- Students loved smelling extracts.
- Pictures on student handouts too small.

Lesson 7:
- Students got into detective role.
- Content complete and well organized.
- Student handouts contained clear information making them helpful for students.
- Instructions and lesson plan were thorough.
- Excellent opportunities for student group work, inquiry learning, and hands-on scientific research.
- Cutting out cards was time consuming.
- Lesson took longer to complete than stated.

Lesson 8:
- Easy to prepare and implement.
- Students learned a lot working in groups.
- Easy to relate to issues in the community.

Lesson 9:
- Easy to prepare.
- Tasks well defined and lesson plan easy to follow.
- Handouts were clear and simple for students to read.
- Students worked well in groups.
- Students interested in experiments.

Lesson 11:
- Easy to related to real-life issues.
- Lesson plan clear and materials easy to obtain.
- References helpful.
- Raised awareness of how plants are used.

EVALUATOR RECOMMENDATIONS

Most teachers were very satisfied with the Economic Botany curriculum. Nonetheless, they still provided some suggestions for improvement. The following recommendations are based on GRG's analysis of teachers' feedback and teachers' direct comments and suggestions.

Improve student handouts
Include more detailed explanations and pictures for students. Two teachers requested color overheads as it would allow them to show students large, color pictures instead of having them use small, black and white pictures from the handouts.

Include suggestions for alternate materials
Some materials were difficult to obtain because of cost and availability, especially the orchids. A list of alternate materials that teachers could use if they cannot afford or locate the listed materials would be helpful.

Include additional examples, especially for Lesson 2.
Teachers felt they needed additional examples to share with their students to help them understand activities, especially for the Lesson 2 concept mapping activity. For this activity, four of five teachers who used it either commented that their students did not understand the concept maps or that they needed to provide additional examples for their students. Adding more examples using topics that students are familiar with would make it easier for them to understand the activity.

Include additional references and resources teachers could use to learn more about a topic.
Some teachers needed to conduct additional Internet and book searches to learn more about topics before teaching them to their students and requested that more information or a list of resources be included with each lesson. Including a list of additional resources for teachers, especially web resources which are easy for teachers to access, might make teachers feel more prepared to conduct the lessons.

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